ELECTRONICS Australia

HIFI NEWS

SEPTEMBER, 1974
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OUR COMPUTER PROJECT: HOW IT WORKS

AUTOMATION IS TAKING OFF!

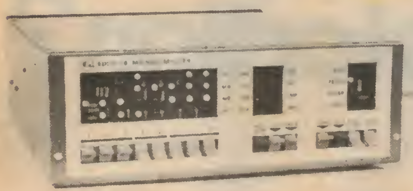
ECONOMY TUNER • STEREO AMPLIFIER

NEW 4-Ch. TEST DISC
SEE P.10

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 36 No 6



Our unique digital computer project has been arousing a great deal of interest. The article which begins on page 34 explains how it works. Even if you're not planning to build the machine, it is well worth reading.

Did you build the Playmaster 136 stereo amplifier? If you didn't, here's your chance to find out why it was so incredibly popular. We have updated and improved the basic design, and present it on page 46 as the Playmaster 143.

This chimpanzee can express herself quite clearly, using language skills developed with help from a computer. See our story on page 33.

On the cover

Former priest and international footballer John Cootes listening to playback of a track from his recently released recording. He is seated at the new mixing console in Festival Records' studio, Ultimo, Sydney. Festival are currently making available a unique 4-channel test record, as we announce on page 10. (Picture courtesy Festival Records Pty Ltd.)

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Editorial Viewpoint

How much do we want local industry?

It is now about two months since the delivery to the Government of the reports on the electronic components industry which were commissioned following the November 1973 tariff decision. In that two months the only official reaction to the reports has been a statement by the Minister for Manufacturing Industry, mainly reaffirming the Prime Minister's earlier announcement that the Government wanted to maintain local production of certain selected components, at least until the Industries Assistance Commission reports on the professional sector of the industry.

In itself, this is perhaps good news for those who believe Australia can and should have a viable components industry. But the remainder of the statement suggests that any cheering would be premature, to say the least. In effect, it says "we don't really believe the industry needs any assistance to continue making components in the short term, although if any firm can convince us that it needs assistance, we may do so."

In this belief they may be right; only time will tell, and perhaps it has already started to do so. However I am frankly disappointed that this rather bland and complacent pronouncement has been the Government's sole reaction to the reports. There were many important matters raised by the consultants in the reports, some with quite profound implications.

Both the Technisearch and A. D. Little reports made the point that if it is desired to help the industry become truly viable and self-supporting, the best way to do this is to provide substantial assistance for R & D. And this involves not only the provision of grants, loans and tax concessions, but a positive policy of encouraging R & D in the private sector.

As the Technisearch consultants rightly point out, private industry has effectively been excluded from serious R & D in Australia to date, apart from a few privileged exceptions. There is no doubt whatever that this has played a significant part in stunting the growth of the industry. Yet to change the situation would require a profound change in the Government's whole approach to nationally funded R & D; for a start, it would be necessary to break the virtual monopoly held by the CSIRO, the PMG and the Department of Defence.

This would perhaps involve a certain amount of trauma, particularly for those boffins hitherto safely ensconced in their Government-run ivory towers. But it would surely not be too high a price to pay for a truly viable and competitive Australian electronics industry.

I only hope that important matters such as this will at least receive serious consideration when the IAC reports are delivered.

— Jamieson Rowe

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THE NEW STEREO BONANZA

"The greatest single sales factor in the present quadraphonic market could be the four-way decoder as applied to standard 2-channel stereo discs."

by EDWARD TATNALL CANBY*

I don't know about the rest of you, but things quadraphonic are crystallising in my mind.

About time!

People have been blowing hot and cold on this subject for years now, and still there is confusion all over, and indecision among the fans.

Momentous threats occur, with the implication that super luxuries like this ought to be banned, or something, as part of the energy crisis.

Is quadraphonic a super luxury? There's a spectre that dies hard! Too many people still cling to the simplistic thought that four is four times too many. Well, if this is your thought, then let's also get rid of the Four B's, Beethoven, Brahms, Bach and the Beatles. Superfluous. Especially for those who never did like them.

In times of incipient trouble, somebody is always going to say that art is expendable and let's do it quick. No frills please, just more gas.

The fact is, though, that in times of really serious trouble such things have a curious way of coming into their own. The modern record biz began in the Great Depression — for me, at least, since that's when I started buying up discs, one by one as I could. There was Myra Hess, the pianist, playing to thousands in London in the middle of WW II bombing. And the sensible WW II conviction in America was that this time around Beethoven and Wagner, though German, should not be suppressed.

All this is not mere sentiment. It goes deeper; it is a feeling that one must desperately hang onto the fruits of a thousand years of human upbuilding, just at a time when those fruits are most in danger; a curious sense, even among people who don't know the difference, that suddenly music and its allied arts are more powerful, more real, more needed.

But quadraphonic? If music itself is needed in the home, and given importance, then quadraphonic is a part of it. A luxury, if you will, of the sort that becomes more cherished as things wax more difficult.

You may gather that I assume quadraphonic to be integrated into the very substance of home listening. It will be! It should be. The more troubles we run into, the more ingenious will be our solutions to the problems of making it widely available.

You can understand, then, why — whammo! — what was once merely a hunch with me has crystallised into an overpowering conviction via recent developments. It needs to be said. A sort of much-delayed bombshell, which has been largely overlooked in the midst of all the revolutionary development. And will those Dyna people in Philadelphia laugh. They've been saying it for years.

The greatest single sales factor in the **present** quadraphonic market could be the four-way decoder **as applied to standard 2-channel stereo discs.**

I am not speaking of quadraphonic discs. They are better, whatever system. But they are also **fewer**, and will be for a time. What we have with us right now is **standard stereo**, in one of the greatest accumulations of recorded human intelligence ever assembled. All of it built up in a scant 16 years or so. Unbelievable. We need more than a passive "also-play" compatibility for these millions. We have it.

Look in Schwann. I've mislaid Schwann's annual statistics, always fascinating reading, and I don't remember whether it's now 60,000 LP items available, a large proportion in stereo, or maybe a mere 30,000. No one person is going to play or own all of these.

But plenty of people jump to a horrendous non sequitur: who needs 'em? It does NOT follow that we need a mere handful of recordings! Your handful? My handful? Here is the very meaning, you see, of the term **library**. In recordings it is a monumental library of availability, like Macy's the World's largest store for everybody, or the Sears catalogue, or the Library of Congress.

And what about the library at Alexandria in Egypt, back in classical times? It was destroyed, and with it vast quantities of the human legacy. Who is to say which parts were more important than others?

Whoa, Canby, you are starting to de-rail. But let's not de-rail.

I return to my point — the quadraphonic decoder of standard stereo records is the most important link between what has been done and what will be done. It is the first thing to consider, today, if you have any sort of accumulated library of stereo records and tapes of your own or plan to build one out of present available largesse.

The trouble is, you see, almost everybody has been putting this last, not first. "Composer circuits!" An extra quadraphonic filip, so you can compose your own on the side, out of your old records. How many engineers have realised the enormous transition importance of this very item? I suspect not even the big matrix boys, who have been so engrossed in their phases and quadratures and vectors that I do believe they have forgotten all about the lowly stereo disc in all its millions.

More power to 'em — that is their business. But let's not let it happen to us, whoever we may be.

What has happened, more or less willy nilly (ie, by sheer purposeful accident), is that these same matrix engineers have stumbled unintentionally on a bonanza and it's working better and better every week. (You have no idea. We reviewers and such are a few steps ahead.)

This is a **fundamental** improvement in stereo reproduction, after the fact. Not merely a heightening of the fi, like, say, the ever-useful reissue of older records remastered for better sound and better surfaces, or the acquisition of improved playback equipment.

The fundamental part is that now, with four speakers and amplifiers, we are able to place some of the ambient, reverberant sound of a stereo record **selectively** away from the direct frontal sound, into a back space where it provides new sorts of listening, a basic improvement in stereo impact from the same old discs.

And what a superb difference this can make at best! Or even at average. It has been getting better and better, too, with more sophistication in the decoding. Decoding, remember, of standard records, **not** quadraphonics. Now we have reached the point of an explosive payoff.

We must be realistic and understand that without the enormous and intensely competitive research on actual quadraphonic sound, we never could have had the present advanced generation of decoding. The engineers could not have evolved the idea to its current sophistication except under duress. It has happened. And now is the time to rejoice.

Well, then, am I obliquely referring to **all** the various quadraphonic systems for playing stereo discs through four speakers? Well, yes, in a way. But I might as well say it: For me there is a definite hierarchy, and here is the inspiration for my present piece:

You may take this from me as an honest and thoroughly tested personal ear reac-

*Copyright article by Audio Magazine, USA, May 1974 issue. Edward Tatnall Canby is Associate Editor.

tion. The latest and best SQ decoding, the "three-chip" SQ-with-logic that is just now getting into marketable equipment is in this special respect ahead of all predecessors and, in fact, is something of a sheer miracle. It just has no right being as good as it is. It can't be! It is impossible! And yet, there the thing is, defying logic, sounding just superb.

As Pepsi used to say, this SQ logic hits the spot. It resonates, speaking purely aesthetically, of course. It is so instantly right in the stereo listening (and I have been listening for some eight or nine months) that I still find myself marvelling each time a new stereo disc blossoms out through its circuitry.

Crazy, considering the well-known complexities and compromises that are involved in all matrix decoding. Too good to be true, but it is true. Not a flaw that I can hear. At least in my own rather wide listening.

Note that the earlier and first SQ with logic was another story, full of all sorts of weird pseudo-effects of the very sort that its critics in other camps had expected. I liked it, but those strange pumpings and flutterings and flyings about of stereo sound? Interesting, psychadelic, and what-not; but they were still too obtrusive, too distracting. Not good. Now, all that is gone. How did they do it? None of my business.

Why bother to buy quadraphonic discs, then? So simple. When they do appear, they are still better, a noticeable improvement in detail and order over the same music decoded from standard stereo. Don't think twice about that; buy quadraphonic discs by preference, tapes, too, whenever the content is what you want.

The point I am making in no way runs down quadraphonic itself, except that in my mind the big step is from standard stereo in two speakers to standard stereo decoded into four speakers, by SQ — or any other systems of equivalent sophistication.

So go right out and acquire your quadraphonic equipment. Just be absolutely sure that you can satisfy your ear on standard stereo discs — check that first.

In the above perspective, you may now observe what may turn out to be a misjudgment, as of right now, in the CD-4 camp. Via CD-4 your stereo is also compatible, but you are mainly offered a type of passive four-channel playback, a sidewise or parallel stereo. The left stereo channel goes into both left speakers; front and back; same with the right side.

Of course you can listen this way. It's OK. But you can do more. Note that there is here no selective rear ambience at all. (Even the original Dyna three-speaker system, throwing the difference signal into the back of the room, does more for you, if with less sophistication.) What you have is simply one stereo channel on each side of you, via two speakers for each channel. According to the inevitable laws of monocity, to make a word, you hear each channel as a vague virtual image between those two speakers, a flat radiator coming at you sidewise. Pleasant but not really much improvement.

Note please, this is not a criticism of CD-4 in respect to its prime intention, quadraphonic reproduction of CD-4 encoded discs. I'm still talking about the things you can do with the discs you already own, the stereo discs still available (and not in quadraphonic) which you would like to hear, hopefully with improvements, on your four-way system.

You can see where my thoughts are moving. Suppose we do get to have quadraphonic equipment, as we surely will, which at a reasonable cost and complexity will handle every sort of quadraphonic disc and decode standard stereo to its best advantage, too, all at the proverbial flick of the wrist. A reasonable proposition, what with new cartridges, mass-produced chip units for both quadraphonic systems, and increasing understanding of what the consumer needs in the way of simplicity.

It'll all happen. The real problem right now with the CD-4 system is not what you think. Not the technical problems in the CD-4 type of quadraphonic. It is this: There just aren't enough CD-4 discs nor enough variety.

If RCA thinks we classical people (I won't speak for pop) are going to live off the nuts in the Nutcracker Suite and similar pleasant but overbaked Philadelphia chestnuts, they have a rethink coming. Nutcracker, my eye. Nice piece until you get tired of it. The SQ repertory in quadraphonic isn't by any means universal, but it goes out maybe 100 times as far already.

If it weren't for CD-4's Elektra/Nonesuch/Warner/Kinney Parking Lots stuff (all one big conglomerate), we'd be in a serious CD-4 software pickle at this precise point. Another biggie, with marvellous stuff on hand, is apparently in the CD-4 future and just about in time. It's starvation. Available repertory! That's what is needed to put over CD-4. And to sell CD-4 equipment. Plus, as I say, competitively adequate circuitry for playing standard stereo discs.

So let's everybody work to do a topmost job for standard stereo in fours. It is the transition hope for all of us, while fancier quadraphonic stuff builds repertory. It's easy, too, now that we see how. In another fifteen years, since most of stereo already comes from 3, 4, 8, 16 or even 32 tracks in the masters, we'll no longer be able to tell much difference — we'll decode or demodulate everything we have, old, new, middle-aged, come what may.

Meanwhile, all of an accident, CBS and SQ have shown us the way for the present quick moment. Others can match the SQ marvels if they have a mind to.

So, dealers, go out now and sell quadraphonic systems for stereo records. The new stereo bonanza. Just think. Millions of discs on hand, and every one wonderfully enhanced into four-way sound! PS. You can also play quadraphonic discs to perfection. Wow! That's the angle, as I now see it.

Goldring: New range of Grundig products

Grundig, one of the best known names on the European audio scene, will shortly be receiving a lot more attention in Australia. Goldring Sales and Service, sole agents in this country for Grundig, are now promoting a wide range of the company's products through hifi retail outlets. Sydney customers will be able to see and hear Grundig and AIWA audio equipment, along with other Goldring lines, at a new centre in the Queen Victoria building in York Street.

Michael Dean, product manager for Goldring, told E.A. that Grundig has given a lot of attention to the needs of European listeners in home units and flats. Equipment designed for this environment is slim and compact, rather than bulky, and concentrates on features which the listener is most likely to appreciate and use.

Typical of modern Grundig styling is the Studio 2040 system illustrated. The slim pedestal mounted console contains a 4-channel amplifier, with SQ matrix, delivering 4 x 12.5W RMS, and with all normal control facilities. The record player is a Dual 12/18 with Shure M91MGD cartridge, while the push-button controlled tuner offers AM, FM, short-wave and long-wave coverage. The two loudspeakers systems shown for 2-channel stereo employ a main enclosure with a multi-way omnidirectional tweeter system on top. Two extra loudspeakers are required for 4-channel reproduction.

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10E18B	10"	18.0	1½"	Bass Guitar	50-70	50-4500	97	60	4¾"
10G54L	10"	54.0	2"	Lead Guitar-Organ	60-80	60-7000	100	100	4⅞"
10G54B	10"	54.0	2"	Bass Guitar	40-60	40-4000	100	100	4⅞"
12C10L	12"	10.0	1"	Lead Guitar-Organ	75-95	70-7000	100	25	6"
12E18L	12"	18.0	1½"	Lead Guitar-Organ	80-100	80-7000	100	60	6½"
12E18B	12"	18.0	1½"	Bass Guitar	45-65	50-4000	98	60	6½"
12G54L	12"	54.0	2"	Lead Guitar-Organ	70-90	70-7000	102	100	6"
12G54B	12"	54.0	2"	Bass Guitar	30-50	30-4000	100	100	6"
15E28L	15"	28.0	1½"	Lead Guitar-Organ	70-90	70-8000	102	60	7⅝"
15E28B	15"	28.0	1½"	Bass Guitar	35-55	30-4000	98	60	7⅝"
15G54L	15"	54.0	2"	Lead Guitar-Organ	70-90	80-8000	107	100	6¾"
15G54B	15"	54.0	2"	Bass Guitar	30-50	30-4000	100	100	6¾"
18G54B	18"	54.0	2"	Bass Guitar	30-50	20-3000	100	100	7⅞"
18K96B	18"	96.0	3"	Bass Guitar	35-45	20-3500	103	125	8"

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The new **Sony TC-137SD** comes with a host of attractive refinements to satisfy the most demanding listeners. The first feature is Sony's newly developed Ferri-chrome cassette tape utilization, adopting advantages of both conventional high quality cassette tape and the chromium dioxide cassette tape. The Ferri-chrome tape gives extended wide dynamic range with rich bass and treble tone and excellent frequency response. Other desirables are Dolby* NR system and Sony's precisely engineered Ferrite & Ferrite head. Due to the Dolby* NR system, tape hiss is cut to a point where it is imperceptible. Ferrite & Ferrite head assures wear-proof tape-to-head contact. Other advantages include: limiter circuit for peak level suppression and peak level indicator for wide range recording; complete auto stop at the end of the tape; greatly reduced wow and flutter of 0.07%. You can mix microphone and line sources at will with the large separate volume controls.

Ideal for use with these two advanced new decks are the Sony **DR-11** stereo headphones with tone and volume controls and mono/stereo switch. Also the Sony **ECM-23** hi-fi uni-directional microphone with 20-20,000 Hz wide frequency range, low cut switch for voice use and metal mesh windscreen. **Sony CO_2 tape** in C-60 and C-90 lengths gives excellent linearity, especially at high frequencies.

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SPECIAL OPPORTUNITY:

Festival 4-channel Test

Amid microphones, instrumentalists and singers. Enoch Light conducts musical passages of test record. Above, he briefs Hawkins on 16-channel recording process. The 16 will be mixed down to four channels (below).

A key album to help in choosing — and using — quadraphonic sound

Electronics Australia has cooperated with Festival Records Pty Ltd to launch in this country an extremely interesting and useful quadraphonic test recording. Intended for the listening situation rather than for laboratory use, it should prove an invaluable aid in evaluating and setting up matrix type 4-channel systems.

The recording was commissioned, in the first instance, by "Popular Science" magazine, to complement the magazine's "Stereo Test Record" released about 6 years ago and still in demand in the U.S. home market. As sold in Australia, the new record will still carry the original Popular Science logo.

Production of the new recording was undertaken by the well known Enoch Light and Jeff Hirst, and by Enoch Light's own company: Project 3 Records.

From the early days of 2-channel stereo, Enoch Light has been well to the fore and it is not surprising that he has been prominent also in exploiting the musical potential of 4-channel systems.

Material for the test recording was laid down in the Project 3 studios on a 16-track master. It was then mixed down to

Final mix puts together technical and musical cuts and narration. Entire track is then recorded on SQ and CD-4 discs, and 8-track and open-reel tape.

Record

The new Project 3 / Popular Science Test Record is intended for use in the home and demonstration room, relying on ears rather than test instruments. (Photos are by Orlando Guerra. Reprinted by courtesy of Popular Science, 1973, Times Mirror Magazines Inc.)

4 channels for transfer to the release recordings.

For the U.S. market Popular Science and Project 3 Records have combined to make it available in four distinct forms: SQ matrix, CD-4 Discrete, reel-to-reel tape, and 8-track cartridge.

For the Australian market the SQ matrix recording is of the most immediate interest and it came up for consideration by Festival, a few weeks ago, through their normal links with Enoch Light and Project 3 Records.

An original SQ pressing was made available to "Electronics Australia" for further evaluation and opinion and we felt that it would indeed be of interest to Australian enthusiasts. Happily, Project 3 Records and Popular Science magazine were pleased to cooperate in having the record marketed in Australia by Festival and introduced by Electronics Australia.

Festival have arranged to produce the record locally and, at the time of writing, the first few pilot pressings have just emerged successfully from their Sydney factory.

Concerning the record, William Hawkins, Electronics Editor of Popular Science has this to say:

"If you already own a four-channel system, you'll use the record to check out frequency response, alignment, and balance — all necessary for getting the best performance from your equipment. Other tests check system wiring and the playing-room qualities.

"If you're just starting a quadraphonic system, take the record along when you shop. Here's what the record contains:

- **Speaker-location and phasing test.** Miswired or improperly marked input or output leads can put wrong or out-of-phase signals into one or more speakers. A series of tones help you check (and correct) both.
- **Balance.** This level-set test allows you to find the right quad balance of volume and tone for your particular system and listening point.
- **Wow and flutter.** This steady tone will point up any unsteadiness in the drive mechanism of your rig.
- **Frequency response.** Similar frequency-response characteristics on all channels is important in four-channel reproduction. A special "pink noise" test makes adjustment easy.
- **Room resonance.** Subtle noises or irritating sounds can be sympathetic vibration from lamps, furniture, windows, or walls. This sweep-tone test helps pinpoint the source.
- **High-frequency response.** A sharp, percussive sound of bells helps you check for proper high-frequency tracking of your turntable cartridge.
- **Bass and transient response.** Good bass and transient response are just as important as high-frequency performance. Carefully chosen and specially played instruments aid you in evaluating them.
- **Additional help.** If you do find problems with your rig, helpful hints in the record jacket tell you how to track down and correct them.

"On the instrumental side are selections by famed Tony Mottola and the Quad Guitars, The Brass Menagerie, The Nashville Jets, and, of course, Enoch Light and The Light Brigade."

The Project 3 / Popular Science Test Record will be available on order through all normal record retail outlets at a recommended retail price of $5.95. However, Festival are arranging to have stocks available in at least one retailer in major cities; these are listed in the Festival advertisement elsewhere in this issue.

What might be regarded as a companion double album has also been released from Project 3 through Festival. It is Enoch Light's "Provocative Quadraphonic" special quadraphonic demonstration 2-record set: LQ-45297 / 8. Retailing for $7.95, it features tracks by "The World's Greatest Jazz Band" of Hank Lawson and Bob Haggart, Tony Mottola on guitar, the Sammy Kaye Orchestra and Chorus, and Enoch Light and the Light Brigade. As an album of very clean popular music, well dispersed in quadraphonic, it is good value.

Hi Fi News

Will FM be shunted sideways — again?

In strong contrast with the flurry of enthusiasm and activity which followed the adoption of the McLean report, things have become very quiet on the FM front. Has it fallen a chronic victim, this time, to current political and economic pressures? Will another round of stirring be necessary?

The release and adoption of the report by Sir Francis McLean (see our May 1974 issue) was welcomed with unbounded enthusiasm by those who had fought so long and hard for an FM / stereo broadcasting system within the normal VHF limits of 88 and 108MHz.

There was even a good deal of speculation as to whether the authorities could be constrained immediately to dust off and fire up the old FM transmitters that had lain idle since June 1961. What if the programs were mono and a split from the national networks? It would be FM and it would be a start!

There was little support for this proposal at administrative level. Apart from the likely makeshift nature of such broadcasts, reactivation of the old transmitters would necessarily have had to anticipate official decisions about policy, licences and frequencies. It was probably too much to expect.

However, while there was little support for what would have amounted to resumption of the early "experimental" broadcasts, officials in both the PMG and the ABC were convinced that they might get the green light within as little as twelve months. Engineering personnel were encouraged to plan for a basic stereo/FM service in anticipation of a monetary grant in the next budget.

Even in the private sector, some were brave enough to take the initial steps towards re-equipment, on the assumption that they had a better than even chance of an FM outlet.

But then the cold winds of financial restraint began to blow and, with them, came the first hint of apprehension that plans for the new broadcasting system could be affected. And each succeeding week has seen still colder winds and signs that the apprehension was well founded.

Instead of planning being left in the hands of the Broadcasting Control Board, the whole matter was diverted for prior consideration by the Priorities Review Committee. Whatever the precise functions and mechanism of the Committee, the move meant one thing to observers: The Australian Government was not only concerned about the "what" and "who" of FM; it was also exercised about the "when".

Again, when Dr Jim Cairns assumed office as Deputy Prime Minister, one of his first statements had to do with the possibility of delaying colour television as an economy measure!

The speculation was short-lived because, with colour television receivers already coming off the assembly lines, and with most stations finalising their installations, colour was way beyond the point of no return.

But the implication was obvious: if the Deputy Prime Minister, and presumably others in the cabinet, were worried enough to consider holding up colour TV, the chances of them giving the go-ahead to FM were minimal — particularly as they were under no great electoral pressure to spend the money.

Salaries, pensions, tariffs, taxes, all have strong political overtones. Delaying a new broadcasting system would be one economy measure that could be taken with scarcely a ripple of protest! It might even be interpreted by the electorate as a responsible decision!

To this point in time, no official policy statement has been made, apart from observations that the matter has been referred to a committee. There have certainly been no positive assurances (a) because no one has been in a position to make them and (b) because Government attention has been focussed on matters economically much more urgent, and politically much more contentious.

As an almost inevitable result, the flurry of interest and activity to do with FM has subsided sharply. Within the PMG and ABC it no longer seems quite as urgent to get the basic stereo signal equipment set up, nor quite as certain that the funds for a continuing effort will be forthcoming.

Importers are having second thoughts about stepping up orders for FM tuners. It's one thing to buy stocks of tuners before world prices inflate even further; it's quite another to have them gradually become obsolete while you wait for a system to get going.

Again the pressure to get UHF tuners into colour TV receivers has subsided and it is certain now that the first generation of new colour sets will go out with virtually the same tuners as their monochrome counterparts. Instead of the new colour sets heralding change, they and their new aerials will only reinforce the status quo.

In practical terms, the "status quo" need not inhibit the setting up of a basic FM / stereo system and, colour or no colour, some FM transmitters could be put into service. But even this initial step would absorb funds, would start arguments among the prime contenders for licences and add to consumer demand — all things that the Government could do without, right now, even if that were the end of the matter.

But, of course, it isn't the end of the matter. A decision to go ahead would, by inference, be a decision to implement the full plan; to inherit the ultimate responsibility, cost and contentions of rearranging television channels and inconveniencing whole cities full of viewers, many with new colour receivers and new antennas for their present local channels.

If the introduction of FM is inhibited now by budgetary considerations and later by even more firmly entrenched television services, full implementation of the McLean Committee recommendations could be a very protracted process indeed.

Curiously (and furiously, for them) those most likely to suffer from the protraction might be the small groups who fought so

Pioneer, claiming to be the "largest speaker manufacturer in the world", have released up-dated versions of two popular models. The smaller is the CS-44G, a two-way system built around a 20cm woofer and a 6.6cm tweeter, and fully sealed. Rated frequency response is 35-20,000Hz and power handling capacity 25W. Recommended retail price is $109.00. Of generally similar appearance, the more elaborate CS-66G is nevertheless larger and heavier and uses three loudspeakers — a 25cm woofer, 16cm mid-range and a 7.7cm tweeter. Also a sealed system, it has the same rated frequency response as the smaller unit but a power rating of 40W. Recommended retail price is $149.00 (Brochures are available from Pioneer Electronics Aust Pty Ltd, 156-8 City Rd, South Melbourne 3205.)

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- 30 cm aluminium die cast platter weighing 1.2 kg.
- 0.1% wow and flutter or less.
- Fitted with MC 10 magnetic cartridge with 0.7 mil diamond stylus.
- Overall dimensions: 460 mm (W) x 357 mm (D) x 185 mm (H).

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A manual player for the connoisseur with advanced tone arm design and extremely low rumble. Perfect for 4 channel.

- Completely isolated 4 pole synchronous motor.
- Less than .07% wow and flutter.
- Full anti skating compensation.
- Fully sprung suspension.
- Fitted with MC 20 cartridge with frequency range to 40 KHz.
- Stylus cleaner.
- Overall dimensions: 500 mm (W) x 405 mm (D) x 190 mm (H).

Price $199

BA 600

A fully automatic design with a simplified mechanism for maximum reliability, featuring:

- Belt driven 30 cm platter weighing 1.2 kg.
- Four pole synchronous motor.
- Less than 0.1% wow and flutter.
- Static balance tone arm with anti skating compensation.
- Fully automatic and manual operation.
- Fitted with MC 8 magnetic cartridge.
- Overall dimensions: 460 mm (W) x 357 mm (D) x 185 mm (H).

Price $169

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strenuously for VHF FM on the assumption that it would best serve their purposes. Even as it was, some of them were allegedly feeling rather disillusioned.

If FM channels are made available belatedly and sparingly, it seems likely that the ABC will get the first piece of the pie, followed by those other organisations who can convince the Government that they have the next strongest claim to the next available channel. Those further back in the queue could find themselves waiting, and waiting, and waiting . . .

In fact, it is likely that some interests will never find their way on to FM, no matter how worthy their claim for airspace.

One of the original ideas of FM on UHF was that there would be room for just about everybody. On VHF there almost certainly won't be.

It now seems apparent that it was the realisation of this fact that caused the Broadcasting Control Board to suggest that additional localised services could be accommodated on the medium-wave AM band. In short, assuming that a considerable number of new services had to be planned into the total system, it was going to be easier to find space for some of them in the medium-wave band, rather than try to crowd them all, in the foreseeable future, on to VHF.

For some groups, more interested in access than high fidelity or stereo, a spot in the AM band would probably be a bonus because just about everybody has one or more AM receivers. There is a huge and immediately accessable audience.

But, of course, for groups interested primarily in music, an AM facility would be so much "second best" as to be unacceptable.

Altogether, it's not a very encouraging picture and FM / stereo enthusiasts may well have to get back to the pen and the typewriter and begin to "stir", all over again!

FM TECHNOLOGY

Mention was made earlier of advances in FM technology which are progressively rendering obsolete traditional design approaches. Fine though they were (maybe still are) tuners using valves, inductors and variable tuning gangs have given place to transistors, ceramic filters and varicap diodes, only to be displaced, at least in part, by IC's.

For example, Fairchild has announced its own version of the 2136 IC which constitutes a substantial portion of the "back end" of an FM tuner.

The 2136 incorporates a three stage if amplifier, plus a quadrature detector and a built-in voltage regulator — all in a single integrated circuit.

Compared with conventional ratio detector designs for FM and TV sound systems, the quadrature detector requires only a single tuning coil. This greatly simplifies alignment procedures, since the coil is adjusted for maximum audible output without using an oscilloscope or signal generator.

Alignment is eliminated altogether if a ceramic filter is used in place of the tuning coil. A complete FM IF strip with no alignment requirements can be constructed by using the 2136 in conjunction with Fairchild's A753 FM gain block, which uses two ceramic filters as selectivity elements.

The internal voltage regulator in the 2136 eliminates the need for external decoupling networks. The regulated voltage also reduces performance variations caused by temperature and supply voltage fluctuations, and acts as a voltage source for tuner circuitry. This makes the 2136 especially suited for automatic frequency control applications using varactor diodes.

TOSHIBA RECEIVER

But, if that approach seems to be right up with the times, consider this description of an FM tuner which has been dreamed up by Toshiba engineers. The following is a quote from our associate English journal "Electronics Weekly".

"Latest example of industrial electronic design and construction techniques being applied to consumer electronic equipment is a VHF stereo hi-fi tuner built by Toshiba. Known as a digital synthesiser tuner it has only one moving part — the push-on, push-off mains switch.

"Circuitry of the tuner is totally industrial in concept, and uses nearly 90 ICs, including a large number of 74 series TTL devices, some of which are from Texas Instrument's 74S Schottky quickened range.

"Star of the IC line up is a complementary MOS dual 50-64 bit static shift register, providing storage for seven preselectable programme channels.

"Non-volatility of the shift register store is ensured by a capacitor which allows stored information to be retained even when the PCB on which the device is mounted is removed from the chassis. Construction of the latter makes extensive use of double-sided PCBs mounted in a Mother-daughter fashion.

"Industrial practice is extended even to the front panel of the tuner. Here the frequency of the station currently being received is displayed in digital form using seven segment LED digits, while function selection is carried out by touch-sensitive pads on the glass facia. Each function selected is indicated by an LED lamp, most of which are green.

"Functions available are a 'DX' facility which allows the tuner to hunt and lock on a station, fine tuning allowing the tuner to be incremented or decremented in either 0.1MHz or 1MHz steps.

"The tuner, which was demonstrated in London recently is a prototype only and consequently has no price tag on it. According to Toshiba representatives there are only three in existence and it is regarded as demonstration of what could be offered rather than a saleable item."

LEROYA IN MELBOURNE

Leroya Industries Pty Lts have announced the opening of a Melbourne office at 103 Pelham Street, Carlton — Victoria.

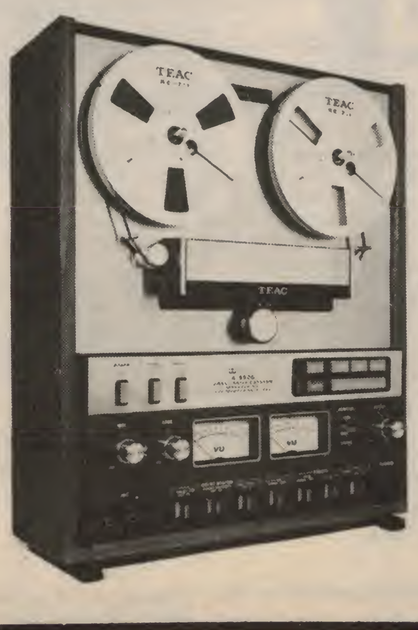
In charge of this office is Mr Peter G. Browne, formerly Sales Manager for Western Australia for Chrysler Australia Limited. Prior to this, Peter was a senior sales executive with Mercedes Benz in Melbourne.

In addition to his extensive marketing experience, Peter brings a "diplomatic" background to the company having been the MP for Kalgoorlie (the world's largest electorate) and Private Secretary to former Prime Ministwr Harold Holt.

The Melbourne office, having been opened within weeks of a Sydney office, gives Leroya a firm grip on the eastern seaboard markets.

Next year should see offices in Adelaide and Brisbane to complete Leroya's plan of having an office in each of the capital cities.

HIGH PERFORMANCE OPEN REEL RECORDERS FROM A.M.I.



"The Quiet Leader Of A New Generation" is the slogan which TEAC are using to promote their A-5500 open reel stereo tape deck. Control of the tape is now by means of quiet touch buttons which take effect through IC logic, largely eliminating the mechanical and electrical noise from interlocking relays and heavy contact switches. An outer rotor motor drives the capstan directly, while electronically governed coreless DC motors provide smooth reel take-up and braking functions. High density ferrite heads, up to the minute circuitry and in-built Dolby system ensure a standard of electrical performance to match the mechanical refinements. Loading is simplified by an in-line tape path which obviates the one-time need to thread the tape along a devious path. The tape configuration is 4-track, either mono or twin stereo, and the speeds 7.5 and 3.75ips.

Model A-5300 would appear from the brochure to share the same basic and electrical features as the A-5500 but without the in-built Dolby feature. In fact, from the front, the only difference is the reduced number of operate switches: five instead of seven. (For information on both machines: Australian Musical Industries, Pty Ltd, 155 Gladstone St, South Melbourne 3205).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Yamaha NS-690 and NS-645 Loudspeaker Systems

Recently released by the Nippon Gakki Company Ltd, are a new range of Yamaha loudspeaker systems. We reviewed the two-way NS-645 and three-way NS-690 systems. They represent a complete change from earlier Yamaha loudspeaker systems.

Back in April 1969 we discussed in the 'Audio Topics" pages the design of Yamaha "Natural Sound" loudspeakers which had large irregularly shaped woofers and open backed enclosures. The shape of the woofers was likened variously by Yamaha technical people to a piano sound board or to the shape of the human ear. Hence "Natural Sound".

For various reasons, apparently, the "Natural Sound" loudspeakers did not meet with great success and they were subsequently withdrawn from the market. Now, there is a new range of Yamaha loudspeakers which are designed along a more conventional high fidelity approach.

The smaller of the loudspeaker systems under review is the NS-645 which is a two-way unit with a 250mm woofer and 45mm dome tweeter plus a variable control which adjusts the volume level of the tweeter to suit room characteristics. The grille frame is removeable to reveal the baffle which is finished flush to the edges in the manner of some JBL loudspeaker systems.

The cabinet is solidly made from dense particleboard and finished in walnut veneer. The baffle is 19mm thick while the side and rear panels are 16mm thick. Inside surfaces of the cabinet are lined with heavy felt and the internal volume is largely filled by batts of fibreglass insulation material which act as an acoustic absorbent.

As may be seen from the photograph, the loudspeakers and tweeter control are mounted flush on the baffle. At the rear of the cabinet is a recessed moulding for the spring-loaded red and black terminals. Enclosure dimensions are 540 x 300 x 259mm and total weight is 14.6kg.

The woofer is a really massive piece of work. It has a ferrite magnet assembly 140mm in diameter and 40mm thick and the voice coil diameter is no less than 70mm. The heavy paper cone has a roll surround which does not seem particularly compliant but the combination of compliance and cone mass results in a free-air resonance of about 25Hz. This rises to a measured 45Hz in the enclosure.

An interesting feature of the woofer is the "dust cap". Normally this would be airtight but one can imagine that the large amount of air trapped under would considerably damp cone travel. Consequently it is made of a fine transparent mesh.

Yamaha term their tweeter a "soft-dome" unit. This means that instead of the dome being made of plastic it is formed from a hot-pressed fabric coated with thermosetting and viscous rubber resins. The voice coil, which is edge-wound, is claimed to withstand temperatures of up to 200 degrees Celsius. The front of the tweeter is protected by a rigid wire mesh.

The cross-over network consists of three metallised dielectric capacitors and two ferrite inductors, to give a 12dB/octave rolloff at the frequency of 2kHz.

Nominal impedance of the NS-645 is 4 ohms and it is rated for a maximum input of 50 watts. Yamaha recommend that the system be used with an amplifier having a power output of at least 20 watts per channel. That requirement plus the fact that the impedance dips to 3 ohms in the region of 3 to 4kHz means that a fairly robust amplifier tolerant of low impedance loads is needed. We imagine that the Yamaha amplifier reviewed elsewhere in these pages would eminently suit the task.

The larger of the two systems, NS-690, has very similar construction to the NS-645. It is a three-way system with 300mm woofer, 75mm "soft dome" midrange unit and 30mm "soft dome" tweeter. Cross-over frequencies are at 800Hz and 6kHz, again with a cut-off characteristic of 12dB/octave. Variable controls are provided for tweeter and midrange.

Enclosure dimensions are 630 x 350 x 291mm and weight is 22kg. A feature of the system is that there are six bridging links on the back of the enclosure which can be removed to disconnect the internal cross-over network and instead connect a three channel amplifier with electronic cross-over. Yamaha give no details here, so unless one was well-informed about loudspeaker design, the feature is of dubious merit.

For the NS-690, Yamaha recommend a 30 watt per channel amplifier. System impedance is 8 ohms and nowhere does it dip below about 6 ohms. The NS-690 is slightly more efficient than the NS-645 but has a higher power rating, 60 watts, so it is potentially louder.

On sweep frequency tests, both systems are very smooth over the whole range. On the NS-645, response tapers off above 12kHz but is well maintained down to 40Hz and below. In contrast, the NS-690 is very flat over the whole range from below 35Hz to 18kHz and beyond. And the tweeter and midrange controls are very useful to make adjustments to suit the room.

On music, the Yamaha loudspeakers have forced us to revise our opinions on Japanese loudspeakers. Indeed, they are probably the best that Japan has ever produced for the hifi market. We prefer the sound of the larger NS-690 but both models give a good account of themselves. Prices are expensive but perhaps not unreasonable in view of their finish and performance.

Recommended retail prices are $299 a pair for the NS-645 and $539 a pair for the NS-690.

Further information on Yamaha products may be obtained from high fidelity retailers or from the Australian distributors, Rose Music Pty Ltd, 17-33 Market Street, Melbourne, or 28 Kent Street, Belmore, NSW. (L.D.S.)

Audiosound AM100 wide range tuner

While FM transmissions in Australia may be just around the corner, the large majority of hifi enthusiasts already have access to a source of fine music signals in the form of the current AM broadcasts from the ABC and better commercial stations. One of the few ways to tap these signals is with the Audiosound AM 100 wide range tuner.

Recent announcements in the media indicate that at last Australia may be provided with a stereo FM multiplex service in the 88-108MHz band, although the current economic climate and Government policies may delay the introduction for quite some time to come.

It was with interest then, that we looked forward to a session with the Audiosound AM Mk II SF wide range tuner, to give its full title. We reviewed this tuner in its earlier form back in May, 1971, and found much to recommend it then. The "SF" designation refers to the sloping front panel of the latest model and also indicates that it contains some recent circuit modifications.

At left, the latest model Audiosound AM100 tuner which uses valves and a luminous tuning indicator.

Housed in a walnut veneered timber case, the Audiosound AM tuner is a compact unit with fairly unobtrusive styling. Still, it would benefit from the services of a competent industrial designer. My immediate recommendation, if I was asked, would be to eliminate the large and differing type faces in favour of uniformity. As it is, the title splashed across the front panel tends to jar the sensibilities.

Dimensions of the timber case are 282 x 140 x 265mm (W x H x D) including the rubber feet. The two knobs on the front panel are for Power and for Tuning. The dial scale is marked with the major capital broadcast stations in Queensland, Victoria and New South Wales and also has calibrations in hundreds of kilohertz. Frequency coverage is from 550 to 1760kHz, so that the unit can receive broadcasts from VL2UV, University of NSW radio.

Perhaps the most important feature of the dial is the luminous ribbon tuning indicator which must be used to obtain correct tuning. More about this later.

On the rear panel is the aerial socket and a miniature toggle switch to cut in or out the 10kHz whistle filter which is so essential in a wideband tuner. A shielded cable fitted with an RCA phono plug is used for the audio output.

Inside, the chassis and its components are different from the original model. The chassis is now made of cadmium-plated and passivated steel and is far more rigid than the original 16 SWG aluminium one.

The circuitry is quite straightforward really and uses a 6AN7 mixer-oscillator and a 6N8 for IF amplification. The detector is a biased germanium diode, which is one of the main features of the tuner. Audiosound claim that it results in low distortion, in contrast to the detectors used in most AM tuners. The luminous tuning indicator is an EM84.

Yes, there are no transistors in the tuner. No apologies are needed for this and anyone who turns up his nose is ignorant of the fact that valves still represent the simplest way of designing a tuner with wideband performance and low cross-modulation. Putting it another way, it is extremely difficult to equal the performance of a carefully designed valve AM tuner with transistors or integrated circuits.

All the circuitry including the two valves but excluding the tuning indicator are mounted on a PC board measuring approximately 130 x 150mm.

The wide bandwidth of the tuner is obtained by stagger-tuned IF transformers. Sensitivity at the aerial input is quoted at 500uV for 25mV audio output, and typical output signal in metropolitan areas is about 200 to 300mV RMS. Audio bandwidth is claimed to be minus 3dB down at 10kHz while the whistle filter gives 40dB rejection at 10kHz when switched in.

As we remarked in our previous review, the most important feature of the tuner is the facility to choose between two aerials: a balanced loop or a single wire. The loop is claimed to give the best results and it does. Made of hook-up wire, with a circumference of 10 to 12 metres, the plane of the square loop is aligned with the direction of the transmitter for best results.

Fairly prolonged listening tests were performed in the reviewer's home in Sydney's northside beach suburbs, where the broadcast signals are perhaps not quite as strong as westward from the coast. With the loop aerial correctly oriented and tuned correctly, the tuner gives excellent quality. Indeed, listening from an adjacent room one can hardly tell the difference between quality ABC broadcasts and the latest stereo records.

Tuning is a little more tricky than on an average radio — you have to tune so that you obtain a slight null between two peaks indicated by the tuning indicator. And the noise-cancelling ability of the aerial was such that I was able to use an electric drill directly outside the window about which the aerial was strung without any interference being noticeable.

I did not worry about listening to country stations, although I was able to pull plenty in. At night, the whistle filter is a necessity and while it does cut the bandwidth, it is not a large reduction. At all times, the signal quality was very clean, meaning distortion-free. It is certainly a revelation after listening to car radios and portables.

Cross-modulation is not really easily checked unless you are in a strong signal area, such as Sydney's western suburbs. There, the tuner, while not absolutely free of cross-modulation, was certainly much less troubled by it than any solid state tuner we have heard, having comparable bandwidth.

In the laboratory, we checked the performance figures. Sensitivity was as quoted. Bandwidth, when tuned to a signal of 1.5MHz, was less than 1dB down at 10kHz. At the bottom of the dial, 550kHz, bandwidth was just on 3dB down at 10kHz. As quoted, the whistle filter gave 40dB rejection at 10kHz but only 0.5dB cut at 8kHz.

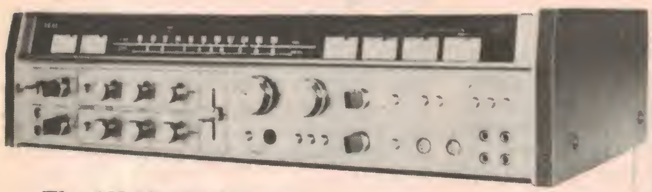
We also measured harmonic distortion of the detector output. At between 90 and 100pc modulation, distortion was less than 1pc. At lower modulation, it was substantially less though it is difficult to quote an exact figure because it was masked by noise. These figures are undeniably good and show just how well a carefully designed and adjusted tuner can perform.

In conclusion, one of the best ways to receive the highest quality AM broadcast signals is with the AM 100 Mk 2 tuner by Audiosound. Its price would not buy twenty full-price records but the selection of programs is wide. It's good to listen to someone else's records for a while!

Considering that the retail price of the Audiosound tuner was quite modest at $94 three years ago, it must be quite a bargain now at $125 including sales tax. For further information, contact Audiosound Electronic Services, 148 Pitt Road, North Curl Curl, NSW 2099. (L.D.S.)

Eat your heart out:

Whoever said that the best things in life are free must have lived a very, very long time ago.
Because, should you decide to purchase this AKAI 2 or 4-channel stereo tape deck and this 2 or 4-channel tuner amplifier, then you'll have to part with around $1900.
Which isn't exactly surprising.
Because they are possibly (modesty prevents us from saying "probably") the world's two most sophisticated pieces of 4-channel equipment.
Not to worry. For AKAI manufacture a wide range of other tape decks and amplifiers.



The AKAI AS 980 tuner amplifier for CD4, Discrete, SQ, and Matrix 4-channel, conventional 2-channel stereo or mono.

As well as tape recorders, cassette recorders, cassette decks, turntables and speakers. Most of which boast many unique features. All of which are superb. And all of which are very reasonably priced. And all covered by the AKAI Complete Protection Plan giving you 12 months warranty, 12 months free insurance and a lifetime warranty on GX recording heads.

For Opera House Lottery winners.
Or, for that matter, the true hi-fi enthusiast, we'd like to say a little about this equipment.
The *AKAI AS-980* stereo tuner amplifier is equipped with high grade circuitry for top quality performance of Discrete, CD-4, SQ and Matrix 4-channel stereo, conventional 2-channel stereo, or mono.
This single tuner amplifier has four independent level meters to assure precise level adjustment, and a highly sensitive FM/AM tuner section.
In short, anything that has been done with 2- or 4-channel sound can be done with this amplifier. Maybe a few other things as well.

Words fail us.
As with the amplifier, the *GX280D-SS* four channel stereo tape deck is in a class very much by itself. And we say that in all honesty. As well as featuring all of the advantages of 4-channel, it also features a repeat circuit for continuous 4-channel playback and 4-channel recording.
In brief: three motors, four heads (including GX Heads with lifetime guarantees), automatic stop/shut off, pause control, sound-on sound, mixing, automatic direct function change, remote control and S.R.T. Switch.

Cats can't always have the cream.
Like we said before, these two pieces of equipment are the ultimate. The cream of the AKAI range. And they are expensive. However there are lower priced models in the AKAI 4-channel range: cartridge recorders and decks, amplifiers, turntables, and reel to reel recorders and decks.
So unless your ambition in life is to conduct the Sydney Symphony Orchestra, we think you'll be more than happy with other AKAI hi-fi equipment.
Quite superb, but not quite so expensive. And still, we hasten to add, well worth eating your heart out over.

The AKAI GX280D-SS 4-channel stereo tape is in a class very much by itself.

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PKB70507

Yamaha CA-800 120W stereo amplifier

Ever wondered whether class-A or class-B amplifiers were fundamentally better for high fidelity reproduction? Here, at last, the question can be resolved by an amplifier which lets you make direct comparisons, the Yamaha CA-800.

Ever since there have been amplifiers, it seems, there has been recurring debate about whether the Class-A or class-B mode is better for power amplification. And the debate hotted up when transistor amplifiers appeared. Now it seems that the argument can be resolved or at least laid to rest for want of a positive conclusion.

Resolution of the aforesaid argument now seems possible because of the introduction of the Yamaha CA-800 solid state stereo amplifier. This unit has a large number of facilities and a performance which justify a lot of interest but it was the ability to operate in the class-A mode which made us keen to try it out. However while the question hangs in your minds, let us discuss the general features of the amplifier.

Like most amplifiers of Japanese origin, the Yamaha CA-800 is very well finished and is carefully designed to provide many operating features. It is fairly large and imposing, with dimensions 436 x 144 x 353mm (W x H x D) including knobs, rear terminals and rubber feet. Weight is 14.0kg.

No less than sixteen knobs and switches are spread out over the control panel. At the right is the large knob for the volume control and concentrically mounted with it is the balance control. Next to this is a smaller knob marked "Loudness". This is different from the normal loudness facility found on many amplifiers, however.

The setting procedure for the Yamaha loudness facility is as follows: with the amplifier in a typical set up, play a record with the loudness knob fully clockwise and the volume control advanced to the loudest setting you would normally wish to use. Now, by rotating the loudness control anticlockwise, the volume is reduced while progressively applying frequency compensation normally provided by the Loudness facility.

In this way, Yamaha hope to compensate for the variations in loudspeaker sensitivity and room size. As far as we were concerned, however, it is more confusing to use. One invariably adjusts the wrong knob to change the volume and the system is just as fraught with the drawbacks described in our article on Loudness in the July 1974 issue (p23). Better to operate the loudness control in the "flat" position (fully clockwise) and adjust the volume control as normally.

To the left of the Loudness control are three rotary switches for Mode, Tape and Function control. These give complete control of input signals and provide for such functions as dubbing between two tape recorders.

On the left side of the front panel are the tone controls. Associated with these are two three-position lever switches which either select the turnover frequency of the controls or throw them out of operation to give a repeatable flat frequency response. A worthwhile feature.

Not so worthwhile is the High filter switch which results in a 6dB/octave roll-off above 6kHz or 12kHz. As we have remarked before, this sort of filter is little more than panel decoration because it is largely ineffective and generally unnecessary.

More useful is the Low filter switch which provides a 12dB/octave rolloff below 20Hz or 70Hz. The 20Hz position is handy to stop large cone excursions caused by wobbles in records, while the 70Hz position is useful for attenuating rumble whether it is inherent in the turntable or on the record. It's also useful for cutting hum, if that is a problem.

A three-position rotary switch selects either or both of two loudspeaker pairs or switches them off for headphone listening. The three remaining lever switches are for Power, Operation (normal or class A) and Muting. This last provides a 20dB cut in signal level for use during telephone conversations, or for low-level listening where the balance between sections of the volume control can be poor. This would otherwise necessitate fiddling with the balance control.

The rear panel is almost the same as any other Japanese amplifier except that it does not have the usual two-pin mains outlets which the supply authorities frown upon. Yamaha have wisely produced a model expressly for Australian conditions, and have left those contentious sockets off.

Gererous ventilation is provided in the top and bottom of the case to allow the considerable amount of heat produced by the output transistors, when operating in class A, to be dissipated. Removing the case to look inside the chassis leaves the amplifier just as inscrutable because most of the circuitry is covered by screens. A good feature is the mounting of the output transistor heatsinks inside the case, so that there is no danger of short circuit or perhaps even burns to the unwary user.

Large electrolytic capacitors, 6800uF, are used in the power supply which has balanced positive and negative rails. The large capacitors are required to provide adequate ripple filtering at the heavy currents used for class-A operation. At the same time, they give extended power capability during normal operation, right down to very low frequencies.

Circuitry of the amplifier is more than usually complex. For example, the magnetic cartridge equalisation preamplifier has four transistors per channel. The first transistor is a voltage amplifier operating at a very low current and it is followed by a Darlington voltage amplifier. Output signals and the feedback are then taken from the final emitter follower.

Three transistors each are used in the tone control and filter stages in each channel. The tone control circuit is unusual in that it appears to be a combination negative feedback (Baxandall) and passive RC circuit. The active filter stage provides the Low filter function.

The power amplifier stages consist of nine transistors for amplification plus seven diodes and two transistors for overload protection. The input stage of the power amplifier is a differential pair with a FET constant current common emitter load.

Yamaha

from p21

Output from the differential pair is fed to the usual class-A voltage amplifier stage with bootstrapped collector load and thence to the fully complementary emitter-follower output stage. As a matter of course, output coupling capacitors have been eliminated to give excellent low frequency damping and power output.

Normal operation of the power amplifier is the class B mode which means that the signal is split between the halves of the output stage so that while one set of transistors is conducting the other set is cut off. "Cross-over" distortion when the signal "crosses over" between the transistors is minimised by slightly biasing the output stage into conduction.

Strictly speaking, this is now the class AB mode since it is somewhere between class A and class B. Anyway, this represents the usual mode of operation in the vast majority of transistor amplifiers.

r With class-A operation, the output transistors are heavily biassed on so that the current through them is just slightly more than the "midpoint" of the resistive load line. For 10 watts sinewave power into an 8-ohm load, the required current is about 800mA, ie, half the peak sinewave current.

In the CA-800, when it is switched from Normal to Class-A operation, the bias on the "amplified diode" current regulator transistor for the output stage is altered so that the output stage quiescent current is changed from 50mA to 900 milliamps. At the same time, the supply rails are reduced from a nominal plus and minus 44 volts to plus and minus 16 volts.

This means that dissipation in the class A mode is about 28 watts per channel or 56 watts total. Which means that the amplifier gets hot!

In theory, there are several advantages in class-A operation. The first of these is freedom from cross-over distortion, since both halves of the output stage are always conducting. Another is improved linearity, because of the smaller current excursions of the output transistors. But perhaps the most important advantage is freedom from the possibility of instability at the point of crossover (in class B mode) due to drastically reduced open-loop gain and the highly reactive load represented by typical loudspeakers. In theory, this potential instability would be manifested as ringing or bursts of high frequency oscillation superimposed on music signals, and could contribute much harshness to the reproduction. In practice, it may never happen!

The transition from Normal to Class-A operation can be performed in the CA-800 with barely a click from the loudspeakers and so one can listen for any subtle changes in the reproduction while all other parameters of the amplifier remain unchanged.

Continuous power output of the CA-800 with both channels driven in the normal mode is rated at 50 watts per channel into 8-ohm load and 60 watts per channel into 4-ohm loads. In class-A, continuous power output is rated into 8-ohm loads at 10 watts per channel.

We measured power output at 55 watts per channel into 8-ohm loads with both channels driven and 66 watts in to one channel. With 4-ohm loads, power was 72 watts per channel with both driven and 90 watts into one channel. This was measured using a regulated 240VAC supply and at a signal frequency of 1kHz.

Power bandwidth (minus 3dB points for the rated distortion of 0.5pc) is rated from 5Hz to 70kHz in Normal operation and to 100kHz in class-A. While it is rather tedious to verify this rating completely, we found it certainly credible. In fact, nowhere in the range from 20Hz to 20kHz at any power output did we measure harmonic distortion at above 0.25pc — at most times it was well below 0.1pc.

Magnetic cartridge sensitivity for full power into 8-ohm loads is 3mV at 1kHz and overload capability at the same frequency is far more than adequate at 300mV. We checked the RIAA equalisation out at considerably less than plus or minus 0.5dB from 20Hz to 20kHz. This is a phenomenal performance and better in fact than many audio generators and millivoltmeters can achieve.

Damping factor was particularly good and we measured it at better than 70 for an 8-ohm load at 50Hz.

Signal to noise ratios ranged from better than minus 90dB with respect to 55 watts for high level inputs to 60dB for phono input with a typical magnetic cartridge fitted. This latter figure is good but not outstanding and it could have been improved if there was a little less hum radiation from the large power transformer.

In the class-A mode, we measured continuous power output into 8 ohm loads at 11.7 watts with both channels driven. We also measured power output in this mode into 4-ohm loads, fully expecting the power to be less, but it was 15 watts per channel. Since the quiescent current in the output stage is only enough to give pure class-A operation into 4 ohms at up to about 6 watts, this indicates that above this power, the amplifier reverts to clsaa AB operation until voltage limiting (ie, clipping) occurs at 15 watts. This when operating into 4-ohm loads, one cannot be always sure that it is class A. An academic point, perhaps, but there it is.

In comparing the two modes of operation, there was no difference in square wave performance into any load and stability at all times appeared excellent. Short circuit and overload protection is comprehensive and appears to be foolproof. The overload circuit mentioned above monitors output current and load impedance and if either is abnormal, it shuts down drive to the output transistors until the condition reverts to normal.

One result of this is that the amplifier will deliver less current into a short circuit than into the specified load at maximum power. Consequently, it is a better form of protection than the often-used "load line" protection system. In addition, there is another circuit which monitors the output for DC fault conditions and in this event trips a relay to disconnect the loudspeakers. This protects the loudspeaker against damage in the event of an output transistor failure.

On music signals, with the amplifier driven by a high quality cartridge and driving equally good loudspeakers, all who listened critically could detect no differences in quality between the two modes. This is understandable on two counts. First, the difference in distortion products is unmeasureable on a distortion meter and only barely visible on an oscilloscope.

On the second count, the amplifier really operates in class A at powers up to about 400 milliwatts into 8-ohm loads, regardless of the mode, because of the 50mA quiescent current through the output stage in the Normal mode. Admittedly, linearity might be better in the "class A" mode. At power levels much above 1 watt, cross-over distortion effects are usually negligibly small in well designed amplifiers.

So there it is, whatever mode is selected, the amplifier is practically as distortion free and faultless as can be made at present. Most people will probably use the Normal mode all the time and forget the class A mode.

While the Yamaha CA-800 may not be the ultimate in stereo amplifiers, it certainly must be one of the finest available in its price range and considerably above it. Recommended retail price is $439 including sales tax.

Further information on Yamaha amplifiers may be obtained from the Australian distributors, Rose Music Pty Ltd, 17-33 Market Street, Melbourne, Victoria, or 28 Kent Street, Belmore, NSW. (L.D.S.)

News Highlights

Ultra-sensitive leak detector in use at Signetics

Technicians at Signetics Corporation's headquarters in Sunnyvale, California, are using an extraordinarily sensitive, portable mass-spectrometer leak-detector to check advanced vacuum equipment.

The leak-detector — the Model 925-40 Porta-Test instrument, developed by Varian Associates — locates leaks in large processing units that are used in the manufacture of semiconductor materials by thin-film deposition and ion-implantation.

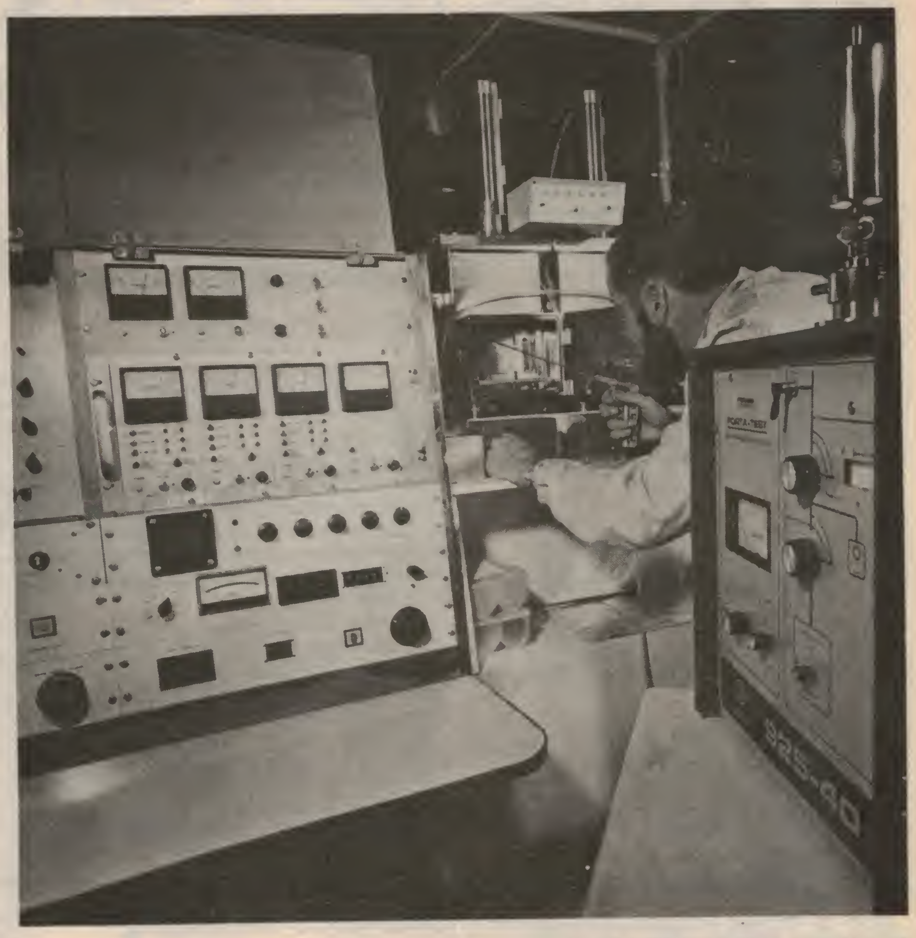
In thin-film deposition, a material such as aluminium or chromium is vaporised and then condensed on a silicon wafer. Ion-implantation involves using ions of such materials as boron, arsenic or phosphorus which are "shot" into the surface of a silicon wafer to produce a conducting material that is later used in manufacturing integrated circuits.

Both of these processes operate under high vacuum. In ion-implantation processing, the vacuum may be as great as 10 to the minus 7 torr, allowing close control over ions moving toward the silicon target. Any reduction in the strength of the vacuum would lead to dispersion of the ions, and a non-uniform semiconductor product. In vapour-deposition processing, the intense vacuum promotes vaporisation of the metal being deposited, and helps to prevent contamination of the wafers being processed.

Signetics technicians use two Varian Porta-Test leak-detectors in the maintenance and repair of their ion-implantation and vapour-deposition equipment. The Porta-Test system — which weighs less than 80 pounds but can find leaks as small as 10 to the minus 10 cc / second — represents a major advance in the engineering of helium mass-spectrometer leak-detectors.

By eliminating the need for a cryogenic trap — a necessary component in all previous designs — Varian produced an instrument that is smaller, lighter and less expensive than any other detector of comparable sensitivity. Operation and maintenance of the detector has become correspondingly simpler and less costly.

In operation, the instrument's testing port is connected to the machine that is to be examined for leaks, the interior of the machine is evacuated, and a small amount of helium is introduced into the air around the machine. At the same time, the diffusion pump that maintains a vacuum in the mass-spectrometer detector tube is adjusted so that it will allow helium to flow backward through it, against its pumping action. Leaks are discovered when helium and air bleed into the interior of the machine being tested. The helium quickly flows backward through the pump to the mass-spectrometer detector tube.



Helium can reach the detector easily because its low molecular weight allows it to diffuse readily, even against the action of the diffusion pump. Oxygen, nitrogen and the other gases contained in air are considerably heavier, and are blocked. And because helium alone can pass readily through the pump, the pump acts as a trap for contaminants coming out of the test piece. It is this innovative use of the pump that has allowed Varian to do away with cryogenic trapping.

When helium leaks through the test piece and reaches the detector tube, a meter on the 925-40 displays the leak rate. Thus, mass-spectrometer leak-detection doesn't rely on subjective judgment or interpretation by the operator, as earlier methods did.

Hank Truitt, in charge of line maintenance on Signetics' vacuum equipment, has been using a Varian Porta-Test unit for several months to check and maintain 18 vapor-deposition machines. Each machine has a built-in leak test port. After connecting the system and evacuating the machine, Truitt can apply a small amount of helium to an individual joint or fitting in the vacuum lines that serve the machine, and thus pinpoint the location of a leak.

Truitt cites the compact design of the Porta-Test method as a major advantage for working in close quarters, and says that the instrument has given excellent performance. In cases that involve gross leaks, he adds, the instrument can withstand high pressures inside the machine being tested, without being flooded or damaged.

The system consists of two compact modules — one housing the power supply and associated electronics, the other containing the diffusion pump, detector tube and leak-rate meter. Approximate dimensions of these respective modules, in inches, are 18x18x9 and 20x9x9.

—George E. Toles.

AWA launches colour TV range

The AWA range of colour television receivers went on sale throughout Australia during August.

At a satellite colour television press conference in Sydney to launch the range, the Minister for the Media (Senator McClelland) and a panel of Australian editors spoke with TV personality, David Frost, in London. It was the first satellite television press conference held in Australia, the first endorsement by David Frost of a commercial product and the first time a "commercial" has been transmitted in colour by satellite from London to Australia.

Mr John E. Bailey, joint managing director of AWA-Thorn Consumer Products Pty Ltd, said he was confident the AWA range would capture the biggest share of the Australian colour television receiver market. Prices of 26-inch and 22-inch sets, which would be the first models marketed, would be between approximately $750 and $950 — about eight weeks' average pay compared with the ten weeks' pay needed to buy black and white sets in the early days of Australian television.

Mr Bailey said the AWA range would have complete back-up in service and components. The company had its own team of specially trained colour servicemen ready for the introduction of colour and, in addition, had arranged for servicing by selected retailers and service companies with known colour facilities.

Artificial vision may become reality

Shown in the accompanying photograph, Mr P.E.K. Donaldson, of Britain's Medical Research Council, examines the latest microcircuit development towards artificial vision for the blind. The new device, which was developed in conjunction with Newmarket Transistors Ltd, is enscapulated in silicone and will operate in a warm biological saline solution.

The system consists of a kind of television camera whose output is fed to a number of small transmitters fitted to the patient's head. These pass RF impulses to electrodes implanted under the scalp which stimulates the visual cortex of the brain. Using this method, patients have been able to "see" braille letters as a pattern of light dots.

The quality of the artificial sight depends on the complexity of the implants. These electrode implants must not only be extremely small, but must also be resistant to corrosion by body fluids. With reliable circuits, artificial vision with the definition of primitive television pictures could be achieved.

Large capacity magnetic bubble memory

A "magnetic bubble" memory that can store information equivalent to 27,000 telephone numbers has been developed by Bell Laboratories.

Magnetic bubbles are minute magnetised areas located in thin films of crystalline magnetic material. These magnetic areas can be created, erased, and moved about electronically to store and transport data in computers, mini-calculators and telephone switching systems.

The new memory has a storage capacity of 460,544 bits of information, and is the smallest yet devised using magnetic bubble technology. The size of the bubble pack is 95mm long, 44mm wide, and 21mm deep.

Magnetic bubble technology has the potential to substantially reduce the size and power requirements of computer memories, and at the same time increase their readability. It is reported that the new memory developed by Bell Laboratories has an average access time of less than 3/1,000 of a second, a data rate of 700,000 bits per second, and a read error rate of less than one error in 630,000 million read operations.

New device monitors infant hearing defects

The incidence of hearing defects in children may be reduced by a new device that can detect hearing loss before a child is one year old.

The device, called the "crib-ogram," was developed by Dr F. Blair Simmons, head of the Division of Otolaryngology at Stanford University School of Medicine, California. According to Dr Simmons, hearing rehabilitation is most successful if it is begun around six months of age, yet hearing defects in few children are discovered before they reach the age of one year.

Heart of the fully automatic system is an inexpensive transducer, originally developed to register the fuel load in aircraft by determining the amount of weight stress on the wing supports. When mounted on the crib, it detects the stress caused by movement in the crib.

The device monitors crib motion resulting from a test sound emitted from a microphone in the ceiling of the nursery. According to Dr Simmons, the hearing test is "simply a matter of determining whether there has been a change in crib activity after a test sound." Test results are scored according to criteria developed through a control study of 5,000 babies in the Stanford nurseries.

Over the past three years, 180,000 tests using the device have been administered to 6000 babies in Stanford Hospital nurseries. Eight babies who failed the test at birth were found, by additional testing at the age of six months, to have hearing losses, thus allowing them to undergo early treatment.

—George E. Toles.

Real-time ticketing and reservation system

A British company has come up with a new recipe for commercial success through the use of computer technology. Their field is leisure and travel, the ingredients are two CDC 1700 computers linked to terminals throughout the United Kingdom.

The firm in question is Seat Reservation Systems (SRS), an independent offshoot of Ticketron of the United States. Set up in 1969, their purpose was to establish a computerised real-time ticketing and reservation system, one that would eliminate the inefficiences and drawbacks of manual systems.

In 1970 SRS purchased Britain's largest ticket agency and began the long job of installing computer terminals in their branches and training the staff to operate them. By 1972 the task was virtually completed and the first ticket buyers were benefiting from the change over. Gone were the long delays often experienced whilst a clerk tried to get through to the box office to confirm a booking or query a date. Instead, the punching of a few buttons brought the information required within seconds, and the command to "Buy" was sufficient to order a slave printer to issue a ticket for the required event.

Before long SRS had expanded into other areas. Several league football clubs joined the system after realising how much simpler the sale of their season and match tickets would be with the computer to keep track of sold and unsold seats for them. The National Bus Company also joined in, as did hotels and tour operators.

The only limitation to the expansion of the network has been the high cost of the Post Office telephone lines which are used to carry messages to and from terminals. For this reason, the company tries to move into new areas en bloc rather than placing a single terminal several hundred miles from the London computer centre.

— Colin Maitland.

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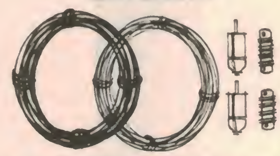

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NEWS HIGHLIGHTS

New advances in Auger spectroscopy

Varian Associates have recently introduced a new system for Auger spectroscopy — an analytical technique so sensitive and precise that it can determine the composition of the top few layers of atoms on the surface of a sample.

The use of Auger analysis is growing rapidly in both basic and applied science. It has acquired major importance in the analysis of thin films, semiconductor materials, catalysts, coatings and other materials whose properties depend on the atomic composition of surface layers.

The principle of Auger analysis depends on the emission of electrons from surface atoms when the sample is bombarded with high-energy electrons. An incoming electron strikes a surface atom, and its energy releases an electron from one of the atom's inner electron shells. To fill this hole, an electron drops inward from an outer shell. In so doing, the inward-moving electron loses energy, which is used to liberate a second outer-shell electron.

This escaping particle is called an Auger electron, and is named after the French physicist who discovered the phenomenon.

The energy of an Auger electron is characteristic of the type of atom — ie the element — that produced it. By detecting the electron and measuring its energy, the Auger spectrometer can determine which element gave up the electron. By measuring large numbers of such electrons, the spectrometer can determine the proportions of different elements in the sample.

Among the most important features of the new system is the small spot diameter of the bombarding electron beam, which makes it possible to analyse areas on the sample surface as small as 5 microns. The same beam can be used to form an electronic image of the sample on a TV monitor to gain a visual and precise means of selecting and analysing specific points on a complicated surface such as an integrated circuit.

Equally important is the advanced depth-profiling capability. In depth profiling, an ion beam is used to remove successive atomic layers of the sample while Auger analysis is in progress. With this technique the spectroscopist can determine the atomic composition of different layers only a few Angstroms apart.

New spectrometer yields off-shore geological data

A towed sea-bed gamma spectrometer, developed by Harwell and the Institute of Geological Science, UK, is being used to produce continuous plots of the natural radioactivity of rocks and sediments on the UK continental shelf.

Employing a sodium-iodide scintillation detector system in a 127mm diameter stainless steel probe, the sea-bed instrumentation is designed to be towed in contact with the sea floor at speeds of 3-4 knots and in depths of up to 200 metres. Gamma radiation from potassium, uranium and thorium sources is measured and separately logged, yielding interpretational data on off-shore geological conditions.

Satellite partners in disagreement

The commercial partners in Marisat, the maritime communications satellite project, are in disagreement over a plan for the use of a voice channel on each of two craft to be launched within the next few months. Marisat consists of two maritime satellites intended to provide reliable, high-quality communications to the US Navy and to merchant ships.

The controversy centres on access to each satellite's single voice channel. Will the majority (80.2pc) owner, Comsat General, have exclusive rights to offer it to users, or will the others — RCA Global Communications (12.5pc ownership), Western Union International (4pc), and ITT World Communications (3.3pc) — have access to the voice channel for a percentage of time equal to their ownership interests. The FCC has issued an order that tends to back Comsat General's view, however the other partners are still suggesting alternate plans.

At least one thing is settled: for the first two years, the US Navy will use at least half, and possibly almost 90pc, of the satellite's facilities for UHF links to its ships. If the Navy does exercise its full option, the satellite's remaining 10pc, which will operate in the L band, will consist of 99 full-duplex teletypewriter channels. It takes about 55 of these channels to make up one voice channel.

Comsat General has said that the channels will be allocated according to the percentage of ownership. In practice, this would mean that Comsat would get 79 channels, RCA 13, WUI 4, and ITT 3. With this arrangement, only Comsat could assemble a voice channel; the others could only offer a teletypewriter service.

Understandably, the other partners are not enthralled by Comsat General's proposal. They propose, instead, that the total channel-hours be apportioned by the month so that the minority holders would have access to the two voice channels at least part of the time, according to their percentage ownership. Despite their differences, however, the companies involved all expect to come to an agreement in the near future.

Magnetic card records colour TV programs

The Sony Corporation of Japan recently announced in Tokyo that it had developed a video record / playback system that makes use of a flat magnetic card as the recording medium.

Designated "Mavica", the system employs envelopes containing two $6\frac{1}{4}$ x $8\frac{1}{2}$-inch magnetic cards. The envelopes are inserted into a small player / recorder which is connected to a colour TV set. Each card set has a playing time of ten minutes of colour picture and stereo sound.

According to Sony, one of the prime advantages of the Mavica system is that high-speed mass duplication of cards is possible, resulting in an inexpensive recording medium. The chief technical breakthrough in developing the system is, however, the production of recording densities on the magnetic cards ten times that on ordinary videotapes. There are no plans at present to market the system.

Lana the chimpanzee converses via computer

It has long been the aim of man to achieve some form of communication with other species, the chimpanzee being one of the main animals with which experiments have been conducted. The first steps towards achieving this goal have already been taken at the Yerkes Primate Research Center in Atlanta, Georgia, where a chimpanzee named Lana is learning to communicate with her human masters via a computer.

by BOYCE RENSBERGER*

Research student Tim Gill peered into a plexiglass room where a chimpanzee named Lana lives with a computer console. Lana pushed a series of symbol-coded buttons on the console and, outside her room, the computer typed out a translation of the symbols — "Please Tim move into the room."

Mr Gill, who read the message in symbols on a display panel above Lana's console, reached down and pushed a button marked "yes." The symbol for "yes" flashed onto Lana's display console and she excitedly rushed over to the door.

Mr Gill, a graduate student at the Yerkes Primate Research Center in Atlanta, opened the door and went in. The chimpanzee took Mr Gill's hand and proceeded to the computer console which acts as their communication medium. Mr Gill pushed some buttons and Lana watched the display panel to see what he said. An automated typewriter monitored the conversation.

"Please, Lana, groom Tim."

"Yes," the chimpanzee answered, and immediately Lana began picking through Tim Gill's hair, carrying out a form of friendly social behaviour common among chimpanzees.

Such exchanges are typical of half a dozen chimpanzees in research centres across the United States that are demonstrating that chimps can learn languages approximating English well enough to converse with human beings.

Although efforts to teach chimps to use human language were largely given up as impossible some two decades ago, renewed efforts using new techniques over the last five years have shown that the animals are capable of learning hundreds of words and chaining them into rudimentary but meaningful sentences. In the past year, some of the chimpanzees have achieved still more remarkable language skills, such as mastery of a rigorous grammar and an apparent understanding of conceptual and abstract terms.

*Correspondent with "The New York Times."

Lana pushes the symbol-coded buttons on her computer console in response to a question from her trainer.

The breakthrough came in the late nineteen-sixties when Dr Allan Gardner and his wife, Beatrice, psychologists at the University of Nevada, hit upon a way to circumvent the inability of a chimp to produce the varying sounds needed for speech. The Gardners tried the sign language of the deaf and found that their chimp, named Washoe, picked it up quickly.

Washoe, who lived in a trailer behind the Gardner home near Reno, learned sign language well enough that visiting deaf people were able to understand her and she them. Her earliest words, in the order she learned them were: come-gimme, more, up, sweet, go, hear-listen, tickle, toothbrush, hurry, out, funny, drink, sorry, please, food-eat, flower, cover-blanket, you, in.

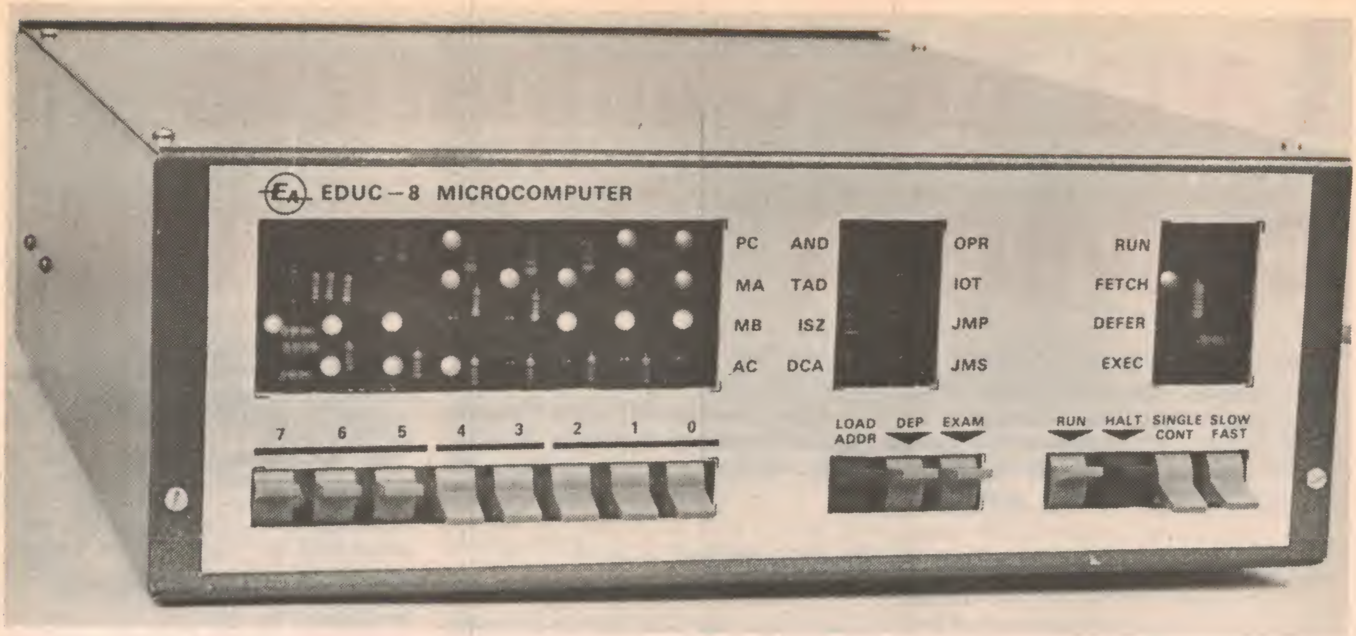
Soon after learning these words, Washoe began combining them into sentence-like strings such as "come-gimme sweet" and "out please." After learning the word "open", she quickly generalised it to ask for the opening of refrigerator doors, car doors, cupboards and jars.

When news of the Gardners' success spread, a number of other researchers thought up alternate ways of communicating without speech. One was Dr David Premack of the Center for Advanced Behavioural Sciences in Stanford, California. He constructed a number of distinctively shaped and coloured pieces of plastic, each signifying an English word, and taught chimps to arrange them in sensible sequences and to understand the meaning of sequences he assembled.

Dr Premack's star pupil was Sarah, a young chimp who knows over 130 words and can construct simple sentences such as, "Ann give apple Sarah." Sarah, now considered too big too handle safely, is in retirement in a cage, and Dr Premack has taken on two younger chimpanzees that are learning quickly.

However, it is the computer-controlled sign language currently being taught to Lana that is creating the most intense interest. "Sign language is fine," says Dr Rumbaugh of Georgia State University, "but it's just too easy to accept an ungrammatical sentence from a signing chimpanzee and take it to mean what you want it to mean." Dr Rumbaugh is head of the computer language research team at Georgia State University and hopes that, through the use of an artificial language programmed into the computer, Lana will adhere to a rigorous syntax — something that observers feel is missing from the signing chimps' language.

(Continued on page 115)



Our do-it-yourself computer: how it works

This is the second in a short series of articles describing EDUC-8, our uniquely conceived build-it-yourself digital micro-computer project. Leading on from the introduction given last month, the author describes the various sections and registers making up the machine, and shows how they operate together as an automatic system.

by JAMIESON ROWE

Before worrying about the construction of our microcomputer, no doubt most readers will want to make sure that they have a reasonably clear idea of the way it works. I am therefore devoting this article to a description of the basic operation of the machine.

At this stage the aim will not be to make the reader intimately aware of every fine detail of the computer's operation, but rather to paint in the broad picture. More detailed discussion of the operation of each section will be given, but later on as we deal with the construction. I believe this progressive approach will help the reader to assimilate the concepts more readily.

Let us begin with a brief revision of basic concepts. You will perhaps recall from previous reading that digital computers are rather unique electrical machines, in that they are capable of performing not just one function, but a number of alternative functions. In fact each computer has a repertoire of basic functional "tricks", any one of which it can perform upon command; ie in response to an appropriate **instruction.**

By making the tricks in its repertoire as basic as possible, and by providing enough of them, the machine is made capable of performing an almost infinite variety of tasks. Any given task to be performed is analysed, and broken down into a logical sequence of the computer's basic tricks. It then follows that if the machine is made to follow the appropriate sequence of instructions, known as a **program,** it will perform the desired task.

By changing the program, the machine can be made to perform different tasks at will. But the point to grasp is that whatever task is to be performed, the appropriate sequence of instructions must be devised, and fed into the machine. Although rightly called a "general purpose" machine, a computer can't do any task at all if it is not provided with a program.

The important thing to remember about the instructions which command the machine to do its basic tricks is that they are binary numbers. Nothing more, nothing less. So that the program which tells the computer how to do a certain task is simply a string of binary numbers stored in its memory.

What is the difference between the instruction numbers stored in the computer's memory, and any other numbers stored there? There is no difference as such. It is all a matter of interpretation.

Essentially, any and every binary number stored in a computer's memory is potentially capable of making the machine perform one of its basic tricks. But at the same time, any given number in the memory only becomes an effective instruction when the computer interprets it as such. So that the trick is to ensure that the machine only interprets as instructions those numbers intended to be such.

Basically this is done by indicating the location or **address** in the memory of the first instruction of a program, before pressing the "run" button to set it in operation. In the normal course of events the computer then interprets the numbers in successive memory locations as the subsequent instructions, unless commanded to do otherwise by one of the instructions. Hence if the computer is started at the correct starting address, and the program is correct (!), only those numbers stored in the memory as the program will be interpreted as such.

Because its operation involves performing a sequence of instructions stored in its memory, a computer operates in a rhythmic or cyclic fashion. In operation it repeatedly fetches an instruction from the memory, interprets it, and then performs or executes the appropriate trick in its repertoire. This cyclic fetch-execute-fetch-execute . . . sequence continues until halted either by

the operator, or by an instruction which itself signifies "halt".

This basic sequence of operations is shown in Fig. 1, which is a simple example of what is known as a flow chart. Such diagrams are often used in analysing and describing computer operation, as we shall see later, because they make it very easy to visualise what is going on.

In this case the chart shows that after starting and performing the fetch-execute cycle for the first instruction, the computer effectively makes a logical decision as to whether it should halt or not. If the answer is no, it returns to fetch and execute a second instruction, and so on. This continues until the answer to the halt decision becomes "yes", either because the operator has pressed the halt button, or because the last instruction performed happened to be "halt".

With the foregoing hopefully clear in the reader's mind, let us now look at the main sections of a computer with the idea of seeing just how it performs its tricks. Perhaps the easiest way of doing this is to look first at the sections of the machine involved with instructions, and then at those involved with data. Some sections will turn out to be involved with both, but this should not be a problem as our next step will be to see how the two groups are fused together to form the complete machine.

Fig. 2 shows the basic sections of the machine involved with instructions. Probably the most easily recognised of these is the memory, and associated with this are two registers known respectively as the **memory address register** (MA) and the **memory buffer register** (MB). A register, you may recall, is a set of flip-flops or similar storage devices capable of containing a binary number.

The function of the MA register is to hold and indicate to the memory the binary number address which specifies the memory location with which the machine is concerned at any particular instant. So that during the fetch phase of the machine's cycle, when the next instruction in the program must be read out of the memory, the MA must contain the correct address of that instruction.

This "next instruction address" is fed to the MA from the **program counter** (PC), a register whose sole function is to keep track of the computer's progress during a program.

Initially, the starting address of the program is fed into the PC, for example by the operator using the console switches. Then, when the number is fed from the PC to the MA to allow the first instruction to be fetched, at the same time the number is incremented (increased by one) and fed back into the PC. This ensures that during the next fetch phase, the MA will be fed with the address of the second instruction. At that time, the number is again incremented, and fed back into the PC ready for the third fetch phase, and so on . . .

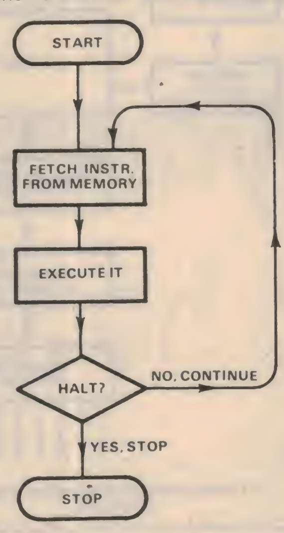
The function of the MB register is to act as an intermediary between the memory itself and the rest of the machine, as far as the numbers actually stored are concerned. Thus when an instruction number is read out of the memory during a fetch phase, it first enters the MB — to regain its composure, as it were.

From the MB register, the part of the instruction number known as the operation code is passed on to a further register, known as the **instruction register** (IR). Don't worry about the significance of the operation code now, as we will look at instruction coding shortly. For the present, it is sufficient to note that this part of the instruction number specifies which **type** of instruction has been fetched, and the function of the IR is to "remember" this vital information during the subsequent execute phase. Without the IR, the computer would literally forget what it was supposed to be doing!

Within the IR register, the operation code is still in the form of a binary number. Associated with the IR is therefore an instruction decoder, whose purpose is to interpret this number and generate the various logic gating signals necessary to perform the appropriate trick.

These, then, are the main sections of the computer involved with instructions. Now let us turn to look at the sections involved with data — i.e., the numbers with which the computer is to perform its tricks. These sections are shown in Fig. 3.

As you can see, three of the sections from Fig. 2 also appear in Fig. 3 — the memory, the memory address register and the memory buffer register. And these perform the same functions with data as they did



1: BASIC OPERATION

with instructions. The MA register is used to specify the address of a memory location into or from which a data number is to be transferred, while the MB register is used as an intermediary store between that location and the remaining sections of the computer.

Together with these three sections we now have an accumulator register (AC), an arithmetic and logic section, and an input-output interfacing section.

Essentially the function of the accumulator register is to retain or accumulate the results of calculations, as they are being performed. If you like, it is the "blackboard" which shows how the sums are progressing.

The arithmetic and logic operations are not generally done in the accumulator itself, but in the associated arithmetic and logic section. However this section, the AC register and the MB register are closely associated, and all three are to some extent involved in most calculations. In binary addition, for example, the two numbers being added are placed initially in the MB and AC registers, and after they are added together by the arithmetic and logic section, the answer is placed in the AC register.

The final main section concerned with data is the input-output interfacing section. As the name suggests, this section carries out the functions involved in transferring data between the computer and its "peripherals" — the input and output devices. This involves not only the simple shuffling of numbers in one direction or the other, but associated tasks such as letting one side know when the other is ready to transmit or receive.

At this stage we have looked briefly at those sections of the computer which are involved with handling either instruction numbers, or data numbers, or both. However the thoughtful reader already may have begun to suspect that there are still further sections of the machine, whose functions have as yet only been implied.

These are the sections involved with run control and timing, and they are shown in basic form in Fig. 4.

Basically the need for these sections arises because the computer operates in a cyclic fashion, as we have seen. Not only this, but in fact both fetching an instruction and executing it each involves a number of steps, which must be done in sequence. Gates must be opened and closed, registers fed with control signals and clock pulses, and so on, all in the right order. And quite apart from this there is the need to be able to control whether the machine is running or not, and similar control functions.

The sections which perform these tasks are the clock oscillator, the run control circuit, the console control switches, the timing pulse generator, and the major state generator.

The purpose of the clock oscillator is to generate the master pulse train which activates the entire machine when it is running. It is therefore by controlling the passage of these clock pulses to the remaining sections that the run control curcuit functions. Broadly speaking, it lets the pulses pass following a command to do so by the console control switches, and continues to let them pass until a command to halt is received — either from the switches, as before, or upon the arrival of a halt instruction.

When the computer is running the clock pulses pass from the run control circuit to the next section, the timing pulse generator. The function of this section is to use the master clock pulse train to assemble a number of timing and gating signals, each of which may be used in various places throughout the machine to perform operations at certain times in each cycle.

Finally there is the **major state generator**, whose function is to define which of the phases or "major states" the machine is in at any given time. Immediately upon being set running, the machine always enters a fetch state or cycle, as we have seen from Fig. 1. At the end of the fetch state it then normally enters the execute state, although as indicated in Fig. 4 there is a third and intermediate state known as "defer". More will be said about this shortly. Finally at the end of the execute state, the machine either returns to fetch and continues, or halts.

I hope the foregoing description has at least given the reader a broad idea of the basic sections which form the computer, and of the general functions they perform. At this stage there will still be many questions unanswered, and you will perhaps be feeling rather unsatisfied. However now that some of the foundations have been laid, we can delve into things in a little more detail.

Let us first look at the instruction coding format used — ie, the way in which the binary numbers which act as the in-

structions for the machine are actually arranged to specify what is to be done.

As you might recall, EDUC-8 uses an 8-bit word format. In other words, both the instruction and data numbers handled in the machine are 8 bits long. For convenience the 8 bits are labelled from 0 to 7, with bit 0 being the least significant bit in terms of binary weighting, and bit 7 the most significant.

When such a number is interpreted by the computer as an instruction, the three most significant bits — bits 7, 6 and 5 — are taken to represent the **operation code**. It is these three bits which are stored in the instruction register and decoded, to specify which type of instruction "trick" is to be performed.

Now you will perhaps remember from basic theory that three bits of information can only represent eight different situations, because there are only eight different bit combinations: 000, 001, 010, 011, 100, 101, 110, and 111. This means that there are basically only eight different types of instruction in the machine's repertoire.

Six of these eight basic types of instruction are known as **memory reference instructions**, because they each involve some sort of operation with a number stored in a location of the memory. Either a number is taken out of the location and used for an arithmetic or logic operation, or a new number is stored in the location, or the number is interpreted as the machine's next instruction, and so on.

The combinations of the three operation code bits used to represent these six instructions are 000, 001, 010, 011, 100 and 101. For convenience we will refer to the equivalents of these in the octal code, which are 0, 1, 2, 3, 4 and 5. (It is very much more convenient to think in terms of octal code than in binary, and I suggest you brush up on the simple relationship between the two. We will be using octal notation fairly frequently from now on, but purely because we humans find it easier to follow. The computer itself deals purely with the numbers in binary form, of course.)

The coding format used for memory reference instructions is shown in Fig. 5(a), where it is indicated that the operation code bits 7,6 and 5 here specify one of the six combinations just referred to. The four least significant bits (0-3 inclusive) are used to define the address of the memory location whose contents are involved in the operation concerned. This is known as the **operand address**.

Don't worry for the moment about the special significance of bit 4; we will return to this shortly. Our more immediate concern is the six types of memory reference instruction, and what each involves. Their mnemonic names are probably already vaguely familiar, because they were given in the specifications panel. Hopefully now you will be in a position to follow the operations themselves.

The instruction type with operation code 0 (octal) is known as the AND instruction. Basically this involves reading out of the memory the number stored in the location specified by bits 0 to 3, and performing a logical AND operation between this number and the number currently in the accumulator register. The AND operation is done on a bit-by-bit basis, and the result placed in the accumulator. As the accumulator will be left with binary 1's only in those bit positions where both initial numbers were 1's, the effect is to "mask" the number in the accumulator with that in the selected memory location. As such, it can be a very useful operation.

The instruction type with operation code 1 (octal) is known as the TAD instruction, which is short for "Two's addition." This is rather like the AND instruction, only the operation performed between the number read out of the selected memory location and that in the accumulator is binary addition, using 2's complement arithmetic, instead of ANDing. As before the result is left in the accumulator. The TAD instruction is the main arithmetic instruction; it can be used for subtraction as well as addition, by forming the 2's complement of the number in the accumulator before the TAD operation is performed.

The instruction type with operation code 3 (octal) is known as the DCA instruction, short for "deposit and clear accumulator." As this suggests, it simply involves taking the number currently in the accumulator, and storing it in the memory location specified by bits 0 to 3. The accumulator is left cleared — ie, with a content of zero.

The instruction type with operation code 5 (octal) is known as the JMP instruction, short for "jump." The effect of this instruction is to cause the address shown by bits 0-3 to be transferred to the program counter (PC) register, replacing the existing content of the PC. This means that instead of the machine fetching its next instruction from the next consecutive location, it will fetch it from the location specified in the JMP instruction. This is a very useful instruction because among other things it makes it possible for the machine to be forced to repeat a sequence of instructions many times.

You will probably have noticed that we have so far ignored the instructions with octal operation codes 2 and 4. These are a little more complicated than the others, so they should be studied a little more carefully:

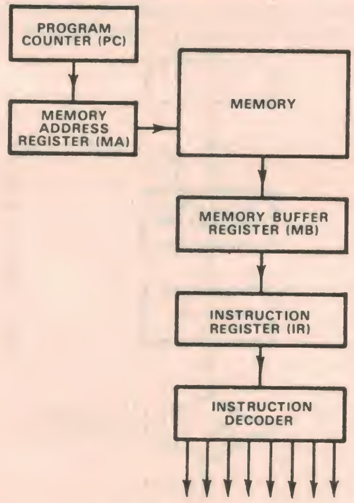
The type 2 instruction is known as the ISZ instruction, short for "increment and skip if zero." It involves the following operations. First, the number in the memory location specified by bits 0-3 is read out, and incremented (increased by one). Then the machine tests the number, to see if it has become zero or not. The number is then stored again in the same memory location. But if the number has become zero after being incremented, the machine also increments the contents of the program counter. This means that the next instruction fetched will not be that in the next consecutive location, but that in the one after that. In other words, the machine "skips" what would normally be the next instruction.

Although it may not be apparent at this stage, the ISZ instruction is a very powerful one. Basically, it allows the machine to make changes in the sequence of instructions automatically during a program, as the result of checking its progress.

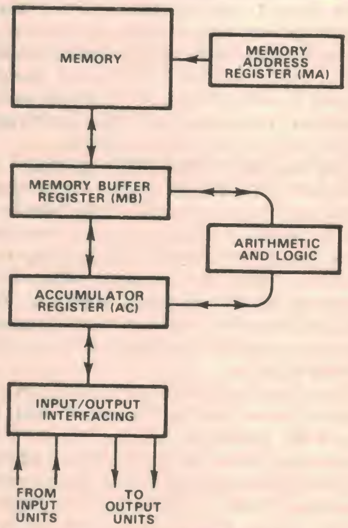
The final memory reference instruction is that with the octal operation code 4. This is known as the JMS instruction, short for "jump to subroutine." Like the JMP instruction, it involves replacing the contents of the program counter register, so that the next instruction is taken from somewhere other than the next consecutive location. But in this case the existing contents of the PC are not lost, as they are with the JMP instruction; instead they are stored, so that in due course the machine can return to the next consecutive location and continue.

A subroutine, you may recall, is a small group of instructions which are used repeatedly throughout a program. Rather than simply repeat them at every place they are needed, which would gobble up memory space, it is far more efficient to store them only once, and simply arrange for the machine to jump over and perform them whenever they are needed. Naturally when this is done, it is essential that the computer be able to keep track of where it has come from in the main program, so that it can return. This is the reason for the JMS instruction.

Basically what happens during the JMS instruction is that the current contents of the PC are taken and stored in the location specified by bits 0-3 of the instruction. At the same time this operand address is incremented, and placed in the PC. This has the effect that the next instruction fetched is taken from the next consecutive location from that in which the original PC contents have been stored. In other words, the computer stores the address in the main program to which it will return, in the first location of a subroutine, and will then proceed to work through the subroutine.



2: BASIC INSTRUCTION-ORIENTATED REGISTERS



3: BASIC DATA REGISTERS AND PATHS

EDUC-8 computer

How it actually uses the stored return address to "get back" will be explained shortly.

Let us now return to Fig. 5(a), and look at the significance of bit 4. As you can see, when this bit is zero it implies something called "direct addressing," while if it is a one it implies something else called "indirect addressing."

Thus far in discussing memory reference instructions, we have tacitly assumed that the only possible significance of bits 0-3 was to specify the actual address of the location in the memory occupied by the operand of the instruction. However this is only one way of using bits 0-3, the way known as **direct addressing**. It is the simplest way, and perhaps the way most readily visualised.

However it is not the only way, nor the only desirable way. In fact there is another way of using bits 0-3, which adds very significantly to the flexibility of a computer from the programmer's viewpoint. In this alternative approach, bits 0-3 are interpreted as specifying not the actual operand address, but the address of a further location in memory, in which the actual operand address in itself stored. Not surprisingly, this approach is known as **indirect addressing**.

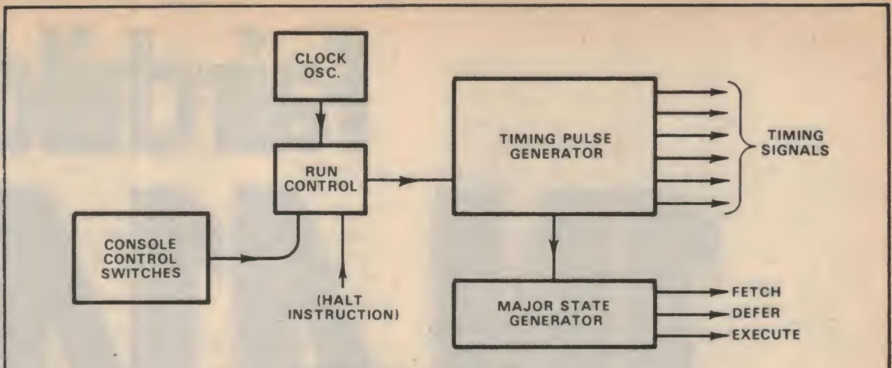
At first sight, indirect addressing may seem nothing more than a more complicated way of doing the same thing as direct addressing. But in fact it opens up all sorts of new possibilities. For one thing, it provides the means whereby the machine can "get back" to the place where it left a main program, from a subroutine. All that need be done at the end of the subroutine is to provide a JMP instruction with indirect addressing, which specifies the address at the start of the subroutine in which the original return address was stored during the JMS instruction.

Another very useful application of indirect addressing is where an operation must be repeated with the numbers stored in a whole string of consecutive memory locations. By using a number in another location as an indirect addressing "pointer," the numbers in the consecutive locations can be made accessible very easily, simply by incrementing the number in the pointer location, between operations.

Naturally enough, indirect addressing involves extra steps compared with direct addressing. The address specified by bits 0-3 of the instruction word must be fed to the MA register, and the actual operand address read out of that location.

The need for these extra steps is the reason behind the third major machine state, **defer**, which we referred to briefly when dealing with Fig. 4. In short, the machine only enters the defer state, between fetch and execute, if it is necessary to perform the extra steps necessary for indirect addressing. Indirect address memory reference instructions thus involve three machine cycles, whereas direct address instructions involve only two.

Indirect addressing also has an advantage over direct addressing in terms of access to all possible memory locations. Unless a rather long instruction word format is used, it is not possible to directly address all locations in the memory. This is because the full range of memory locations involves more addresses than there are bit combinations available in the instruction word, after the operation code bits and direct / indirect indicator bit are accounted for.



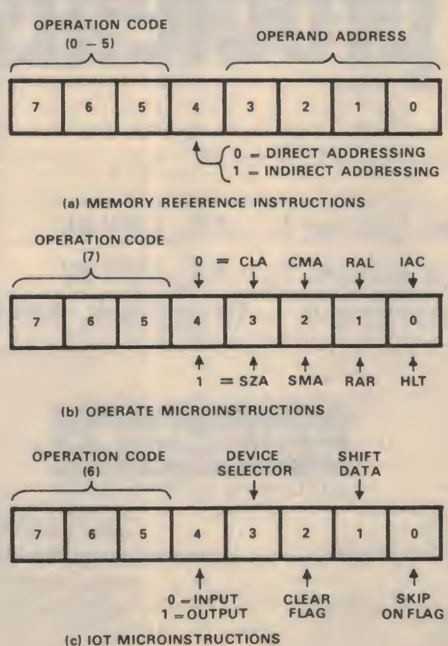
4 : RUN CONTROL AND TIMING

In EDUC-8, for example, only bits 0-3 inclusive are available for the operand address, and these four bits are capable of specifying only sixteen possible addresses, whereas the memory actually has twice that number. (If bit 4 were added, all 32 locations could be directly addressed, but we would then have no way of indicating indirect addressing). A similar situation exists with many computers, particularly those using relatively short words.

This difficulty is avoided by arbitrarily splitting up the memory into groups of addresses called "pages," and adopting the convention that an instruction can only address directly those memory locations in the same "page" as the instruction itself. Thus in the case of EDUC-8 the memory is visualised as being split into two pages, consisting of the first sixteen locations and the last sixteen respectively.

The computer is then designed so that when direct addressing is involved, it automatically adds the missing fifth (most significant) bit of the operand address, making it the same as that of the instruction itself. In effect, it "assumes" that the specified direct address is in the same "page" as the instruction.

While with indirect addressing it is still necessary for the location in which the actual operand address is stored to be in the same page as the instruction, the operand address itself can occupy a full word, and can thus specify any location in the whole of the memory. Thus with EDUC-8 the stored operand address can be anything up to 8 bits long, sufficient to specify 256 locations — ample for the 32 locations actually present, and with room for future memory expansion!



(a) MEMORY REFERENCE INSTRUCTIONS

(b) OPERATE MICROINSTRUCTIONS

(c) IOT MICROINSTRUCTIONS

5 : INSTRUCTION CODING FORMATS

Let us now look at the two remaining types of instruction provided by EDUC-8, and the coding formats used for them. The first we will look at is that with the operation code 7 (octal), which is known as the OPR or "operate" type of instruction.

Although there is only the one operation code associated with this type of instruction, it is actually subdivided into eight different and distinct microinstructions, some of which may be combined to form further microinstructions. What makes this "subdivision" possible is the availablility of bits 0-4; because this type of instruction does not make reference to the memory, these bits are not required for specifying an operand address. They can therefore be used to extend or "augment" the basic operation code.

The way the additional bits are used to specify the eight different OPR microinstructions is shown in Fig. 5(b). Rather like the memory reference instructions, bit 4 is used as an indicator bit. However in this case it is merely used to indicate which of two possible meanings is to be placed on 1's in the remaining four places. When bit 4 is zero, bits 0,1,2 and 3 are used to specify the four micro instructions IAC, RAL, CMA and CLA respectively. On the other hand when bit 4 is a 1, they specify instead the microinstructions HLT, RAR, SMA and SZA respectively.

The mnemonic IAC stands for "increment accumulator." As the name suggests, this microinstruction simply involves incrementing or adding one to the number in the accumulator. If the AC is initially zero, then it will contain the binary number 1 following the IAC microinstruction.

The mnemonic RAL stands for "rotate accumulator left." This involves shifting the number in the AC one bit position to the left, so that the content of bit position 0 moves to position 1, 1 to 2, 2 to 3, and so on. The content of bit position 7, if there is any, is shifted around into bit position 0. For binary numbers less than the equivalent of decimal 127, RAL corresponds to multiplication by two.

The third of this group of OPR microinstructions is CMA, which stands for "complement accumulator." It involves taking the number in the accumulator and changing it into its 1's complement — ie, each bit is turned into its complement. Bits which are initially zero become 1's, and those which are initially one become zero. If the AC is initially cleared (all zeroes), the

CMA instruction gives it a content of one.

The fourth OPR microinstruction is CLA, which stands for "clear accumulator." This is almost self-explanatory; the contents of the AC are simply wiped out, leaving the AC bits all zero.

The first of the OPR microinstructions for which bit 4 is a 1 is HLT, short for "halt." The effect of this instruction is simply to cause the run control circuitry of the machine to stop the passage of master clock pulses to the timing pulse generator, at the end of the current execute cycle.

The next of these is RAR, standing for "rotate accumulator right." This is virtually the opposite of the RAL microinstruction, causing the number in the AC to be shifted one position to the right. The content of bit 1 is moved into bit 0, that of bit 2 into bit 1, and so on. The content of bit 0 is moved around and into bit 7, so that as before no bits are lost. In effect the RAR instruction corresponds to a division of the number in the AC by two.

The seventh of the OPR microinstructions is SMA, which stands for "skip on minus accumulator." The effect of this instruction is to cause the content of bit 7 of the AC to be tested, to see if it is a 1 (by convention, the most significant bit of a number is taken to indicate its sign — 0 means positive, 1 negative). If this bit is a 1, the contents of the PC register are incremented, so that the next instruction is fetched not from the next successive memory location but from the location after that.

And lastly there is the SZA microinstruction, which stands for "skip on zero accumulator." This is similar to the SMA instruction, but involves a test of all bits of the AC, not just bit 7. In this case the contents of the AC are incremented only if all AC bits are zero, so that a clear AC causes the next instruction to be skipped.

The SMA and SZA microinstructions are both very powerful ones from a programmer's viewpoint, because they provide a means whereby the program can test the result of a calculation, and automatically decide upon a course of action.

Some of the OPR microinstructions may be combined to form further microinstructions. Thus CLA and IAC may be combined, allowing the AC to be given a content of 1 by means of a single instruction. Similarly CLA and CMA may be combined, which has the effect of setting the AC to a content of-1. The CMA and IAC microinstructions may also be combined, allowing a number in the AC to be changed into its 2's complement using only one instruction. And finally the SZA and SMA microinstructions may be combined, so that the next instruction is skipped if the AC is either zero or minus.

The main advantage of these combined microinstructions is that they save memory space, allowing more program to be fitted into a given number of locations. They also make a program run faster, because in effect two separate "tricks" are done in a single execute cycle.

The final type of instruction provided by EDUC-8 is that with the operation code of 6 (octal). This is known as the IOT instruction group, where IOT stands for input-output transfer. Like the OPR instruction type, this type is also sub-divided into a number of microinstructions, and as the name suggests, these are all concerned with the transfer of information between the computer itself and any input and / or output devices to which it may be connected. The coding format used for IOT microinstructions is shown in Fig. 5(c).

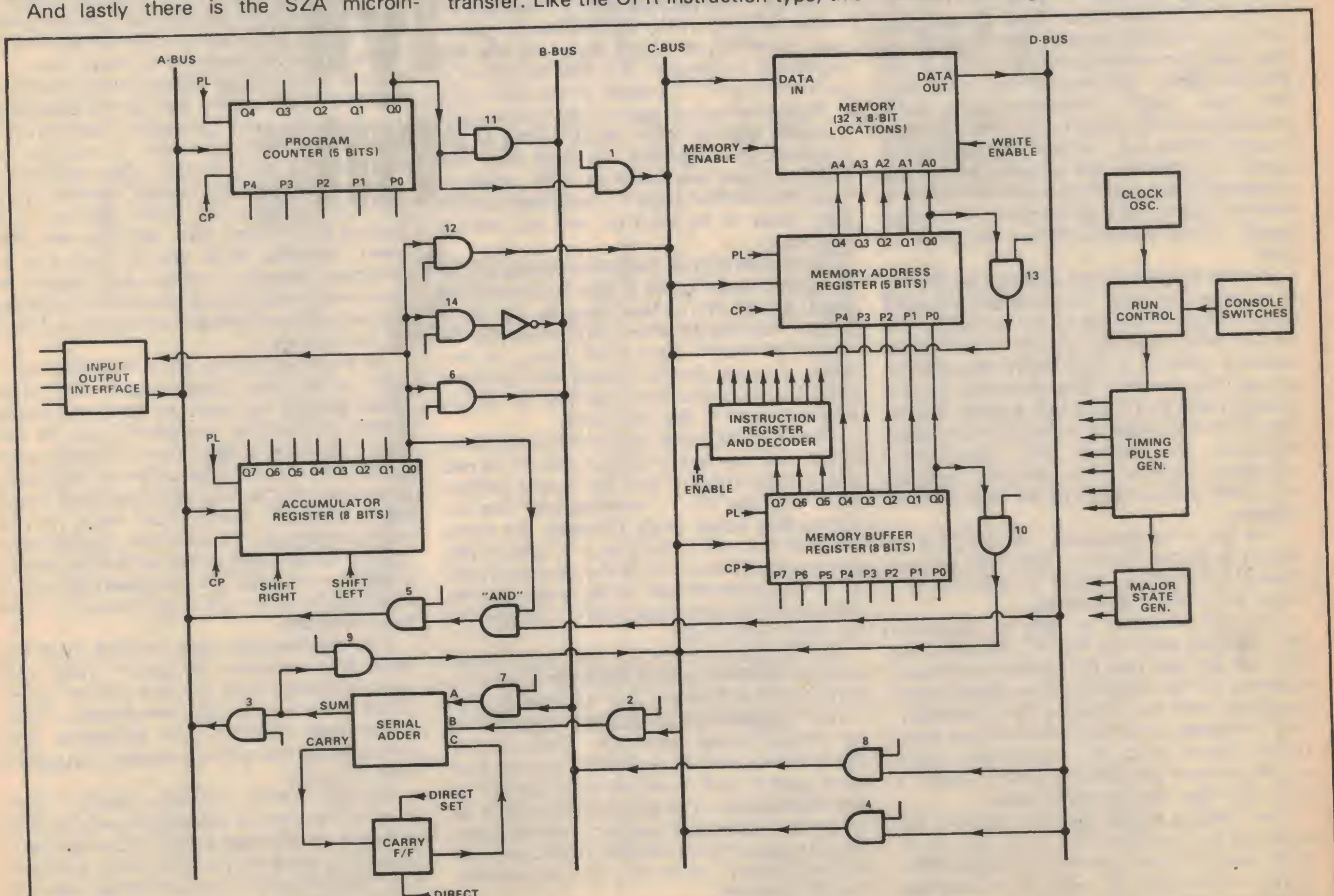
As before bits 7, 6 and 5 are used for the operation code, in this case 6 (or binary 110). And bit 4 is again used as an indicator bit, this time to specify whether the instruction concerned refers to an input device, or an output device. A zero is taken to specify an input device, and a 1 an output device.

Bit 3 is also used as an indicator bit, in this case to select which of the two devices of each type the instruction is concerned with. Thus if bit 3 is a 0, the instruction is concerned with either input device "0" or output device "0", depending upon the value of bit 4. Similarly if bit 3 is a 1, the instruction is concerned with either input device "1" or output device "1".

Between them bits 3 and 4 are thus used to specify which of the four possible input-output devices an IOT microinstruction is concerned with. Hence even when four devices are connected to the computer, each can be dealt with individually.

Bits 0, 1 and 2 of the IOT instruction format are used for the three different types of IOT microinstruction. In other words, these three bits form the augmented operation code.

When bit 0 is a 1, this corresponds to a "skip on device flag" microinstruction. The effect of this microinstruction is to check whether the input or output device concerned has signalled its readiness to take



6: EDUC-8 · BASIC ORGANISATION

part in a transfer of data, by setting a flip-flop known as its "flag". If the flag is indeed set, the contents of the PC are incremented so that the next instruction is fetched not from the next successive memory location, but the one after.

There are two alternative mnemonics for this microinstruction, SKF and SDF, used for input and output devices respectively. In either case the purpose of the microinstruction is to allow the computer to determine when a peripheral device is ready to "do business."

The second type of IOT microinstruction is that having a1 in the bit 1 position. This is the "shift data" microinstruction, represented by the mnemonics KRS (input) and LDS (output) respectively. As the name suggests, this microinstruction is the one which actually causes data to be transferred between the computer and a peripheral. In the case of an input unit, the data is transferred from the input unit into the AC of the computer. With an output unit, the data is transferred from the AC into the output unit.

Finally there is the third type of IOT microinstruction, in which bit 2 is a 1. This is the "reset device flag" microinstruction, represented by the mnemonics RKF (input) and RDF (output). Fairly obviously, this microinstruction causes the flag flip-flop in the device concerned to be reset, and it allows the computer to signal to the peripheral device that a data transfer is complete. This allows the device concerned to perform whatever housekeeping operations are needed to prepare for a further data transfer.

The "shift data" and "reset device flag" IOT microinstructions may be combined, as they take place at successive times in the execute cycle. This forms the "shift data and reset flag" microinstruction, with mnemonics KRB (input) and LDB (output), in which there is a 1 in both bit positions 1 and 2. As before, the advantages of the combined microinstruction are the saving in memory space, and an increase in running speed — two instructions for the price of one!

By this stage you are perhaps beginning to wonder just how the computer does all these things. And that is, so to speak, the 64,000 dollar question. In the limited space available here it is not really possible to answer the question fully; however for the present I will try to give you a basic idea of the principles involved. Hopefully this will be sufficient to provide the background necessary for the more detailed analysis which will be developed as we look at each section.

The basic organisation of EDUC-8 is shown in Fig. 6. This is essentially a combination of Figs. 2, 3 and 4, with the addition of a little more detail.

You will hopefully be able to recognise the registers, such as the PC, the AC, the MA, the MB and the IR, together with such sections as the memory, the input-output interface, and the timing pulse generator. The arithmetic and logic section has been broken down into its component parts, which are now identified as a serial adder, a carry flip-flop, and an AND gate.

The various signal paths between the registers and sections are now shown in more specific form, with controlling AND gates indicated in various strategic positions. These are numbered so that we can refer to each conveniently. Note also that there are four main signal "highways" or **bus lines**, arbitrarily labelled the A-bus, the B-bus, the C-bus and the D-bus. The main control signals fed to each register and section have also been indicated.

Essentially, the computer functions by means of control signals applied to the registers and the gates controlling the various signal pathways. And the control signals are formed by suitable combinations of signals from three sources: the timing pulse generator, the major state generator, and the instruction decoder.

At first sight this seems a delightfully general and vague statement, I know. The only real way to give it more meaning is to look at a specific example. Hopefully you will then begin to see the general principles involved, and will be able to visualise more of the machine's operation for yourself.

Let us consider the fetch cycle, in which as we have seen the computer must perform the operations necessary to read out the next instruction from its memory location, and decode it ready for execution. You may recall that the address of this instruction is contained by the PC register, prior to the start of the fetch cycle.

What happens is this. At the start of the fetch cycle, the carry flip-flop is set to contain a 1 by means of a signal applied to its direct set input. This signal is produced by combining the "fetch" signal from the major state generator with a suitable timing pulse from the timing pulse generator.

Following this gate 1 is opened for five clock periods, by means of a control signal produced by combining the "fetch" signal with another signal from the timing pulse generator. And because gate 1 connects the output of bit 0 of the PC register to the C-bus, to which the bit-4 input of the MA register is connected, this has the effect of connecting the PC output to the MA input.

The same control signal used to open gate 1 is also used to admit clock pulses to the PC and MA registers, so that they are simultaneously activated as shift registers. Thus the number in the PC is shifted into the MA, ready to be used to read out the instruction.

At the same time, the same control signal is used to open gates 2 and 3, connecting the C-bus to the A-bus through the serial adder. This has the effect of connecting the output of the PC back to its input, via the adder. And the control is used also to admit clock pulses to the carry flip-flop, so that it can take part in the operation.

The effect of this second set of operations is that the number initially in the PC is not only shifted into the MA, but is also shifted back into the PC — incremented. The incrementing takes place because the carry flip-flop was set to contain a 1, before the shifting took place. Hence the number in the PC is now incremented, ready to provide the address of the next instruction — needed for the next fetch cycle.

During the next part of the fetch cycle, another control signal of eight clock periods duration is produced by combining the "fetch" signal with a suitable signal from the timing pulse generator. This control signal is then used to enable the memory, to open gate 4, and to admit clock pulses to the MB register. The effect of all this is to cause the instruction number in the memory location specified by the MA to be read out of the memory, bit by bit, and shifted into the MB register.

Following this yet another control signal is produced, lasting for a single clock period, and again formed by combining the "fetch" signal with a suitable signal from the timing pulse generator. This control signal is used to enable the IR register and decoder (the two are actually combined in a single IC), so that the operation code formed by bits 7, 6 and 5 of the instruction are taken from the MB, stored and decoded.

Finally, the last operation of the fetch cycle takes place. This involves the production of yet another control signal, formed by combining the "fetch" signal as before with both a suitable signal from the timing pulse generator, and a signal from the instruction decoder which indicates whether or not the instruction fetched is a memory reference type or not. The control signal thus formed is used to open a gate (not shown) which connects the output of bit 4 of the MB register to a flip-flop in the major state generator known as the "defer status flag".

The purpose of this last operation is to signal the presence of an indirect addressing memory reference instruction, if one is present, to the major state generator. This is so that the major state generator will enter a defer cycle, if necessary, before starting the execute cycle.

I hope this example will start to give you an idea of what was meant by the bold face paragraph above. Although we won't be able to trace through the operation of the machine during the defer cycle or the execute cycle — particularly for each of the various types of instruction (!) — you may by now be able to see the basic principles involved.

Table 1 gives an analysis of the steps involved in each of the various machine cycles. Using this and the example just given as a guide, you should hopefully be able to trace out what happens in each case.

In a nutshell, the various major states or cycles are defined by the signals generated by the major state generator. Each cycle is then effectively split into a number of segments by the timing pulse generator, which produces appropriate signals lasting various numbers of clock periods. The signals from these two sections are then used, together with signals from the instruction decoder, where appropriate, to produce control signals which are applied to the various signal gates and registers. That's all there is to it!

As the table shows, each cycle lasts for a total of 24 clock pulse periods. Not all of these periods are used to generate timing signals and initiate operations, but the 24-period duration of the cycles has been used to simplify the circuitry of the timing pulse generator. At the two alternate clock pulse rates provided, each cycle lasts for 48 microseconds or 12 seconds, respectively. Thus at the fast rate, a normal fetch-execute sequence lasts for 96 microseconds and a fetch-defer-execute sequence 144 microseconds.

You will perhaps have noticed from the table that besides the fetch, defer and execute cycles, there are two further cycles which we have not yet mentioned. These are marked **deposit** and **examine**, and perhaps their names have already suggested their purpose.

Basically, these are both special "one-shot" cycles mainly associated with control switches on the front panel of the machine. Deposit is used to manually enter numbers (such as instructions) into selected memory locations, while examine is used to manually read out the contents of selected memory locations, for checking. Both are used

TABLE 1 — CYCLES & INSTRUCTION TIMING

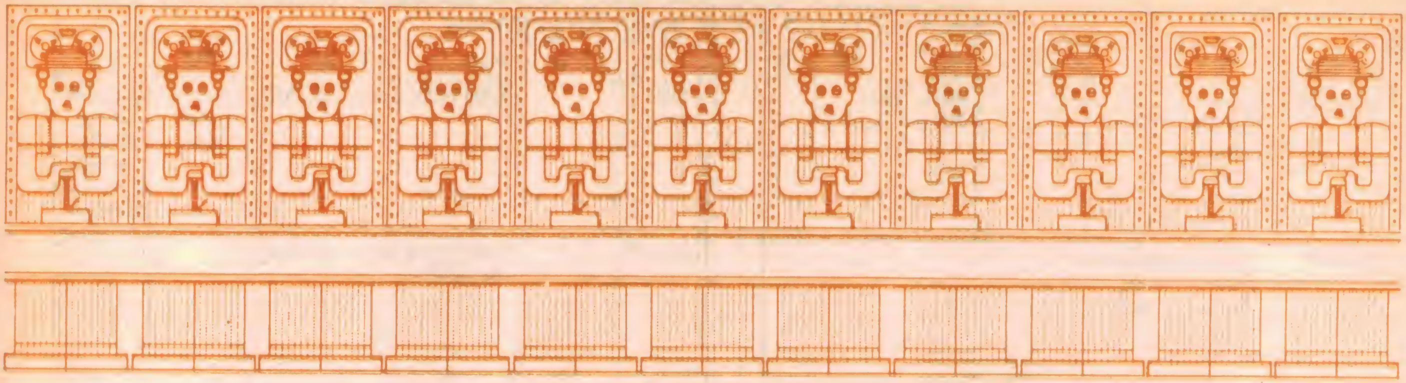
CYCLE		T0	T1	T2 —	T5 — T9	T10	T11	T12	T13	T14 — T17 — 21	T22	T23
FETCH		Clear MA, IR, carry (also mem strobe)	set carry		PC to MA, PC +1 to PC			clear carry		Read instruction into MB	Load IR (last half)	set defer status, MA4 to MB4 if m. ref. instruct.
DEFER		Clear MA, carry, mem strobe	MBO-4 to MA					ditto		Read operand address into MB		
EXECUTE	**AND**	ditto	ditto	Read out operand into MB, AND with AC, result into AC				ditto				
	TAD	ditto	ditto	Read out operand into MB, 2's add with AC, result into AC				ditto				
	ISZ	ditto	ditto, set carry	Read out operand, increment and put result into MB				ditto	Set carry if MB=0	Write contents of MB, circulate PC through adder		
	DCA	ditto	MBO-4 to MA	Write contents of AC, load into MB also				ditto				
	JMS	ditto	ditto	Write contents of PC, also load MB				ditto	Set carry	Shift MA into PC via adder		
	JMP	ditto	ditto					ditto		Shift MA into PC (via adder)		
	SKF, SDF	ditto						ditto	Set carry if flag=1	Circulate PC through adder		
	KRS, LDS	ditto		Shift data between device and AC				ditto				
	RKF	ditto						ditto	reset i/p flag			
	RDF	ditto	reset o/pflag					ditto	reset o/p flag			
	IAC	ditto	set carry	Circulate AC through adder				ditto				
	RAL	ditto	shift AC one bit L					ditto				
	CMA	ditto		Circulate AC through inverter				ditto				
	CLA	ditto		Shift contents out of AC				ditto				
	HLT	ditto						ditto				reset run flag
	RAR	ditto						ditto	Rotate AC one bit R			
	SMA	ditto						ditto	Set carry if AC = −	Circulate PC through adder		
	SZA	ditto						ditto	Set carry if AC = 0	Circulate PC through adder		
DEPOSIT		ditto	set carry		PC to MA, PC+1 to PC			ditto	Load MB from SR	Write contents of MB, restore in MB		reset run flag
EXAMINE		ditto	ditto		ditto			ditto		Read into MB		reset run flag

primarily for loading in programs via the console switches, and then checking that the instructions have been loaded in correctly.

Associated with the deposit and examine switches on the front panel of the computer is a third switch, marked **load address.** The function of this switch is to allow a starting memory address to be loaded into the PC register prior to either depositing, examining, or setting the machine running.

The remaining controls will be discussed next month, when we start dealing with the construction of the machine.

Stay with us!



Computerised automation is taking off

Assembly tasks on mass production lines are often simple, monotonously repetitive, and are an obvious application for automation. Computer controlled machines have already permeated into some industries, and it is only a matter of time before sophisticated computerised systems are capable of taking over most mass production tasks. This article discusses the implications of computerised automation in mass production environments.

The concept of industrial automation is hardly new. It began with the industrial revolution, yet automated equipment and procedures have changed relatively little over the years. For the most part, human workers still guide the machines, carry the parts from one machine to another, keep track of what each machine is doing, test and assemble the parts and inspect the finished products.

Many of these jobs are as mindless and tiresome as Charlie Chaplin's was in "Modern Times" nearly 40 years ago. Worker dissatisfaction with these dull, repetitive chores is widespread. Even generally high wages and fears of recession have not quietened labour unrest in many plants. The work stoppages, slowdowns and absenteeism that have often resulted from this dissatisfaction have led to decreased output, poor product quality, and thus to escalating production and repair costs.

Most of these routine jobs could be done by computer, says Dr Charles A. Rosen, Staff Scientist, who has been developing computer-based automation systems at Stanford Research Institute (SRI) for several years. "This could eliminate many undesirable jobs," he says, "and provide new man-machine relationships requiring more human intelligence and thus restoring man's purpose and dignity."

Dr Rosen visualises factories in which many repetitive jobs would be done by computer-controlled machines supervised by a smaller but more highly trained work force than is used today. The workers would be capable of setting up (ie, programming) each job, modifying procedures, changing over for new models or batches, maintaining the equipment, and using their intelligence to cope with stoppages and breakdowns. Thus, in effect, they would be "time-sharing" their capabilities among many machines.

Freed from the relatively low-level jobs that can best be done by machines, the human workers would be able to devote their time to those more challenging tasks that now either cannot be done by machine at all or can be done only with inordinately expensive computer hardware and software. Such jobs would include programming the assembly, inspection and materials handling systems, as well as systems repair and maintenance.

The seeds of this dream exist today. Already, computer control is widespread in chemical processing and some segments of the automobile industry (ref. "Electronics Australia", April 1972). It is rapidly invading the petroleum industry, particularly oil production, and the aerospace, communications and electronics industries. As electronics takes over, more and more functions that have historically been performed either mechanically or electromechanically will be achieved by computer-controlled machines.

This rapid growth is sparked by plummeting computer costs and the spread of electronic control systems which are cheaper, more reliable and faster than electromechanical or mechanical controls. A minicomputer-based control system that cost $100,000 five years ago would come to about $25,000 today. David Penning, Senior Industrial Economist at SRI, whose background combines several years in computer production with extensive long-range technical and economic planning experience, predicts that by 1980 the price of such a computer control system may have dropped to between $5,000 and $10,000.

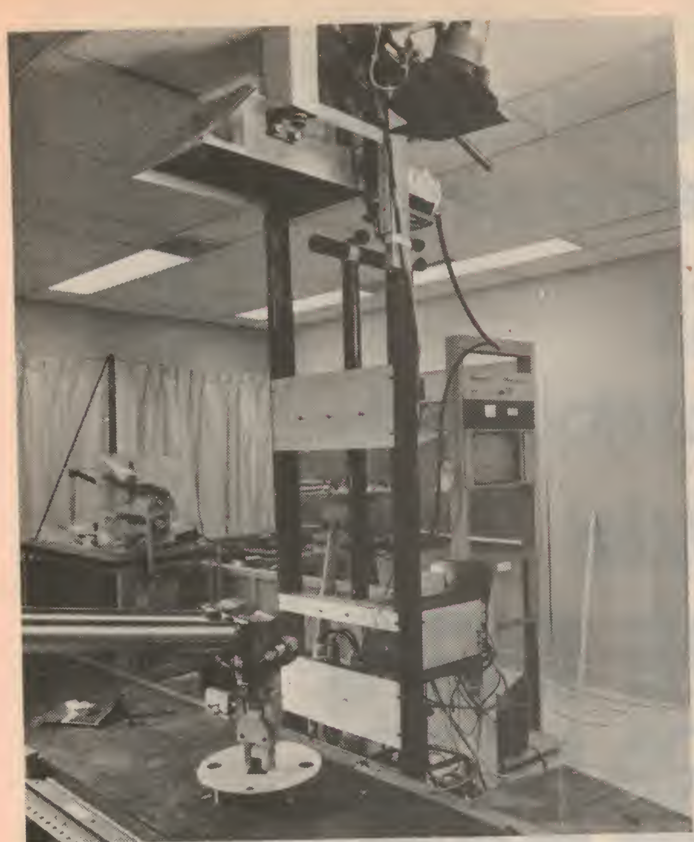
Penning expects the electronics industry (including communications) to be a spearhead for automation as this industry is familiar with computer-based electronic control techniques and therefore has the ability to adapt such techniques to production requirements. Also, electronic products tend to be functionally so complex that only a computer can test them rapidly enough to make testing economically feasible.

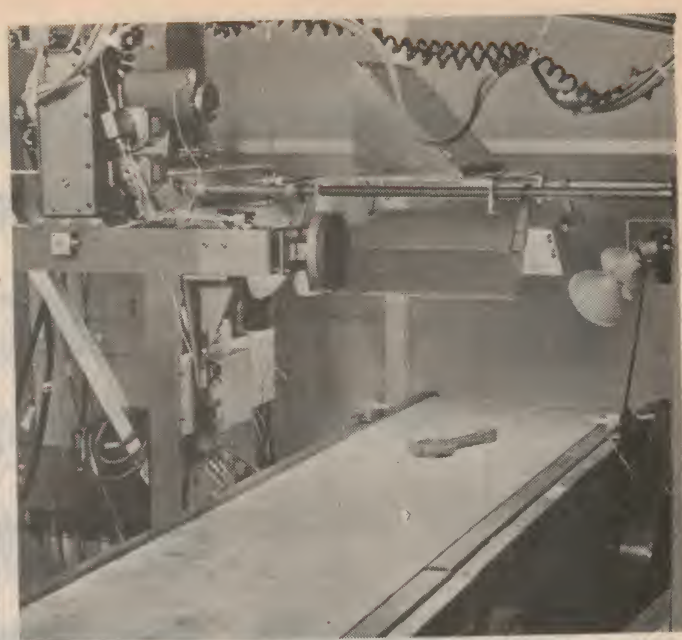
Moreover, electronic products are subject to rapid obsolescence. Television, for example, has gone from vacuum tube parts to transistors and on to integrated circuits in about 10 years. This rapid product evolution makes it feasible for the electronics manufacturer to consider changes in production equipment as soon as his product becomes obsolete rather than waiting until his equipment wears out.

For the electronic equipment manufacturer, therefore, computer-based automation makes sense today. Penning points out that in 1972 one TV manufacturer increased its profits by 55pc and its sales by 30pc by automating its production line. At the same time, the company cancelled plans to build four factories overseas and hired 3,000 more US workers, with the result that the company's union now strongly backs automation.

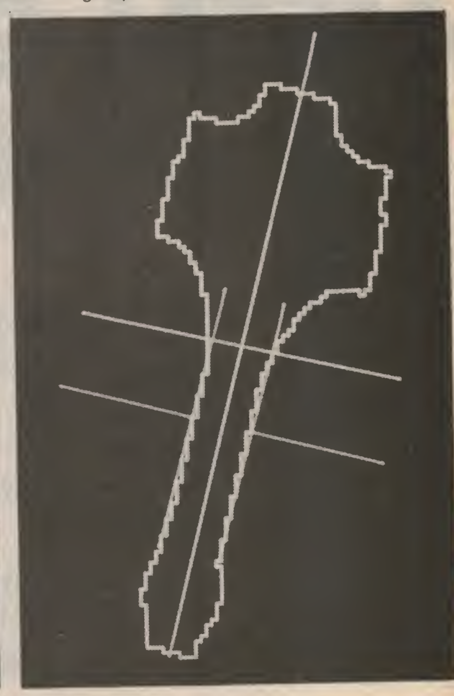
Today, the computer is extensively used for testing electronic products. In addition, it is beginning to take over metal cutting and fabrication in many industries. In the so-called "direct numerical control" (DNC), one computer controls many machine tools. In "computer numerical control (CNC) each machine has its own small "dedicated" computer to guide it through the machining of complex contoured parts made of exotic metals.

By 1980, Penning expects that computerised manufacturing will have penetrated further into a variety of in-





Above, this prototype vision system, developed at SRI, is able to recognise an object on a moving belt and determine its position and orientation. By using this information, the manipulator (above, left) is able to grasp the object and move it to some desired location. The system can also be programmed to recognise and manipulate an object by means of an interactive programming routine using TV displays of the object. For example, by means of a light pen, the programmer can move certain lines (below) to those points where he wants the manipulator to grasp the object.



dustries. Not only will electronic testing and machine tooling be more extensively computerised than today, but also the computer will be used to monitor equipment and collect data as to which machines are doing what chores and how efficiently. Without a computer, it is difficult for a plant manager to keep current information on these operations.

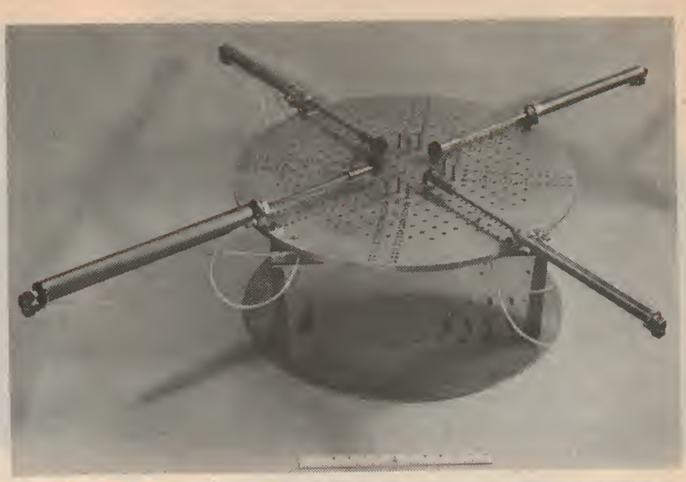
Major operations still to be taken over by the computer are programmed materials handling, inspection and assembly. These would be systems that could be easily programmed to perform a variety of operations on objects of different sizes and shapes. Typical operations would include moving parts from one place to another, remembering where they are located, picking them up off a conveyor belt while they are in motion, inspecting them for completeness, damage, spots and stains, making sure their dimensions are within tolerance, and putting them together to make a finished product, which is then further inspected.

Materials handling operations are already underway in some factories, using simple programmable manipulators, sometimes called robots. They are used for such jobs as loading and unloading presses, stacking parts, spot welding and paint spraying. But these devices have, as yet, no more than rudimentary sensory equipment, such as a photocell. As a result, they can only manipulate objects that are fixed in a precisely predetermined position. They lack the sensory feedback as well as the hardware and software capabilities needed to perform two-handed operations. However, they can be programmed to perform a wide variety of simple tasks involving certain specified movements.

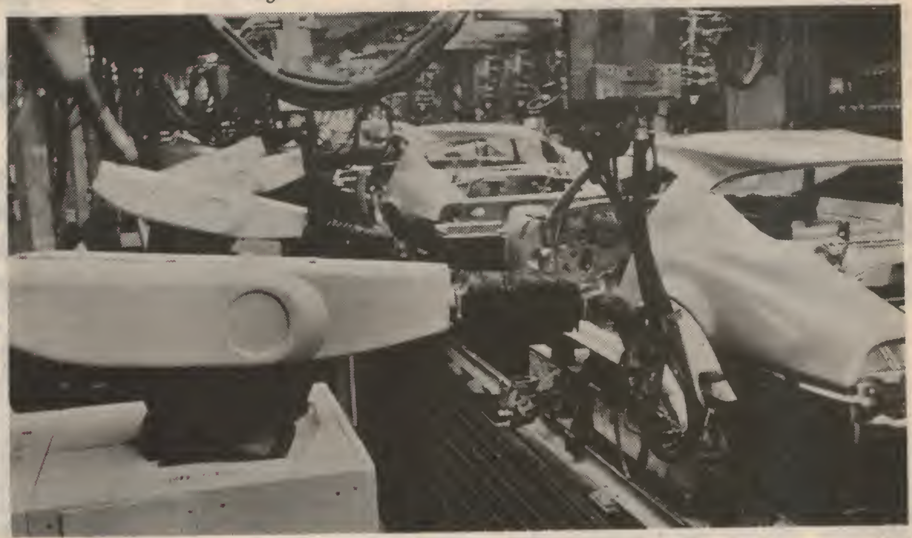
A human worker programs the manipulator by moving it through the desired motions once, then going back and making small changes in its sequence of operations until he is satisfied with its performance. An average production worker can acquire the skill needed to do this in a month or two.

Computer-controlled inspection and assembly systems are further over the horizon. Virtually the only ones now in use are single-purpose systems that can sense such characteristics as dimensions or colour but cannot be programmed to do more than one task. Programmable systems will be difficult to implement because of the almost infinite variety of objects to be assembled and operations to be performed. The objects may range from nails to automobiles, while the operations to be performed on them may range from measuring the length of the nail to putting tyres on an automobile.

Equipment that could sense and manipulate such a variety of objects has not yet been developed. Two-handed operations, such as putting a tyre on a vehicle as it moves down a production line, can be performed in the laboratory, but the systems are not yet practical. The manipulators will have to be improved and the software refined and simplified so that it can be incorporated into a small computer. Moreover, it will be necessary to develop



At left, this developmental hand or end effector incorporates arrays of tactile sensors in the "fingers" together with torque and force sensors in the "wrist". The computer controlled turntable pictured directly above is capable of rotating a part into a known orientation. Below, General Motors' production line uses some 26 "Unimate" robots to weld bodies together for one of GM's small cars, the Vega.



high level computer languages that come as close as possible to spoken language so that unskilled personnel can be quickly trained to program the system to do different jobs.

Until recently, higher level computer languages were not practical to use with many minicomputers because of their limited memory capabilities. In order to translate the languages into voltage levels which the computer can understand, a great deal of computer memory is required. With rapidly falling costs of computer memories, however, the situation has begun to change. As a result, it would be feasible to trade off computer memory for ease of programming, if the programs were available.

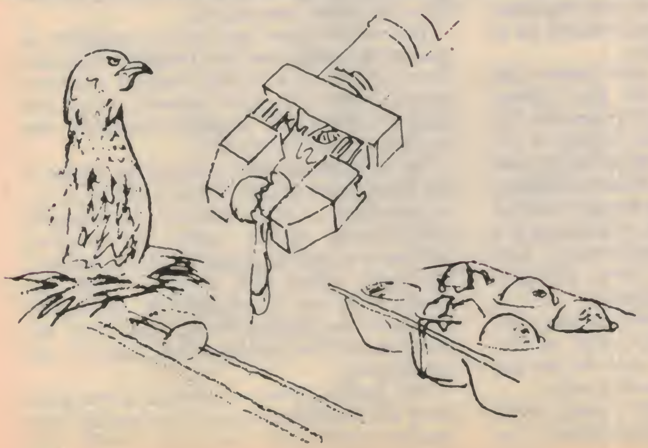
Dr Rosen heads a group of scientists at SRI who are developing both programs and hardware for a variety of programmable systems under a contract with the National Science Foundation. The objectives of the two-year program are to develop a range of manipulating, visual sensing and inspection systems and, finally, an integrated assembly and inspection system that incorporates materials handling, acquisition, assembly and inspection operations, all easily programmable and potentially cost-effective.

In December, 1973, at the end of the first 6 months of the program, the group had completed a materials handling system with visual and touch sensing. For the visual sensing, both a TV camera and an array of linear diodes are being used. Both visual sensors convert the optical image to electronic signals. These signals are processed by the computer, which then identifies any of 6 or 7 different objects and directs the manipulator to pick them up and place them in a specified location. Tactile sensing is done by the "hand" and "fingers." Light detectors sense the movement of the fingers, and the computer relates this movement to the amount of pressure applied by the fingers. The system can identify and pick up objects in motion.

"It is not very good at this yet," says Rosen, "but it is getting better."

He points out that none of the systems thus far developed at SRI would be cost-effective in a factory because they require the capabilities of a large computer. Even if the computer were time-shared among many different factory operations to bring down the cost per operation, the system would still not be practical in the factory. The whole factory would have to shut down if the computer failed. Within two years, however, Rosen expects to have simplified and streamlined the software enough so that it could be used in a self-standing minicomputer-controlled system that would be cost-effective in the factory.

Long term goals for the project include the development of a system that could respond to voice commands such as "a little higher," "two centimetres to the right" etc. The attainment of such a goal would obviously provide a significant impetus to the introduction of widespread automation. Whatever the case, the age of computer controlled automation is on the edge of reality.



In spite of the progress made so far, we still have a long way to go.

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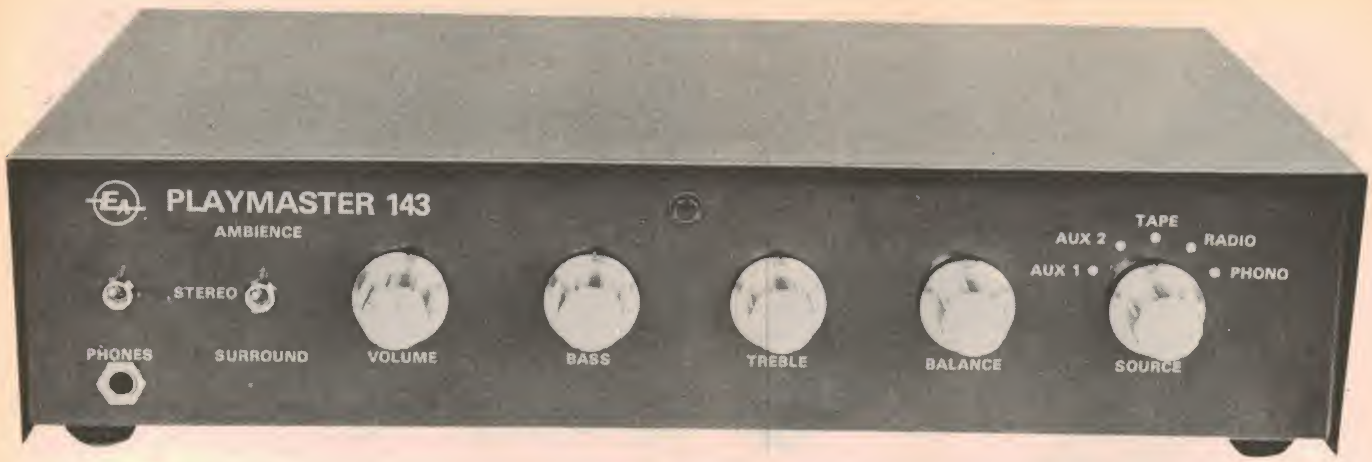


PLAYMASTER 143

. . . a new high performance stereo amplifier

Here is the design for a new high performance stereo amplifier, based on our extremely popular Playmaster 136 design. While rather similar to the earlier design, it offers improved performance and additional features, including a stereo headphone socket and more flexible quadraphonic simulation. It has been designated Playmaster 143.

by DAVID EDWARDS

The Playmaster 136 solid state stereo amplifier design which we published in the December 1972 and January 1973 issues was, without a doubt, our most popular project ever. The last time we heard, the estimate of the number that had been built ran well into five figures!

At the same time it has also been a very successful project, with few constructors encountering any trouble. To the best of our knowledge, most amplifiers worked first time and are continuing to give their builders satisfaction.

Electronics is an ever-changing activity, however, and it is inevitable that things have changed in the eighteen months since the Playmaster 136 design was presented. For example some of the transistor types used are no longer available, while other types suitable for the design have recently made their appearance.

Since the original design was published, we ourselves have gained more experience with the power amplifier modules used, and have come up with an improved module which we used recently in the Playmaster 140 quadraphonic amplifier. We have also found ways of reducing residual hum and distortion level, to make a further improvement in overall amplifier performance.

In view of these changes we thought it desirable to present here an updated version of the original design, incorporating all of the improvements and modifications evolved to date. At the same time, we have kept the overall styling and construction of the new design as similar as possible to the original 136, to minimise additional cost.

In terms of facilities, the new design is rather similar to the original except for two features. One is that it offers a stereo headphone socket, which the earlier design lacked. The other feature is an improved quadraphonic simulation circuit, which while still very simple, offers two different simulation modes in addition to normal stereo.

The input DIN sockets have also been arranged in the same way as in the Playmaster 140, following the accepted DIN conventions. We have used the same power amplifier boards as in the 140, and the same pre-amplifier and tone control board as in the original Playmaster 136.

In the Playmaster 136, each power amplifier board contained its own power supply components. This arrangement did lead to some problems with regard to circulating ripple currents penetrating the input wiring. To overcome these problems, we have used a single power supply, similar to that of the Playmaster 140, consisting of a 30-volt centre-tapped transformer, four rectifying diodes and three chassis-mounting electrolytic capacitors.

As the power requirements of the new amplifier are smaller than that of the Playmaster 140, we were able to use the original Playmaster 136 transformer.

We have not followed the recent trend towards using slider potentiometers, as these present difficulties with respect to mounting. It is much easier to drill or punch a round hole in a chassis than to make a thin rectangular slot, especially for the home constructor making his own chassis. For this reason we have retained the original type of rotary controls in what is essentially a budget-conscious design.

The basic arrangement of the new amplifier is shown in the block diagram. Input signals are accepted by the five input sockets. The phono signal is processed by the pre-amplifier, which also serves to apply the required RIAA equalisation, before being fed to the source switch, along with the four other inputs.

After selection of the required signal, it passes the balance control and then proceeds into a buffer stage. The required signals for the tape socket are taken from the output of this stage, being therefore unaffected by the volume and tone control settings of the amplifier proper. Program material can therefore be recorded quite independently of the listening level.

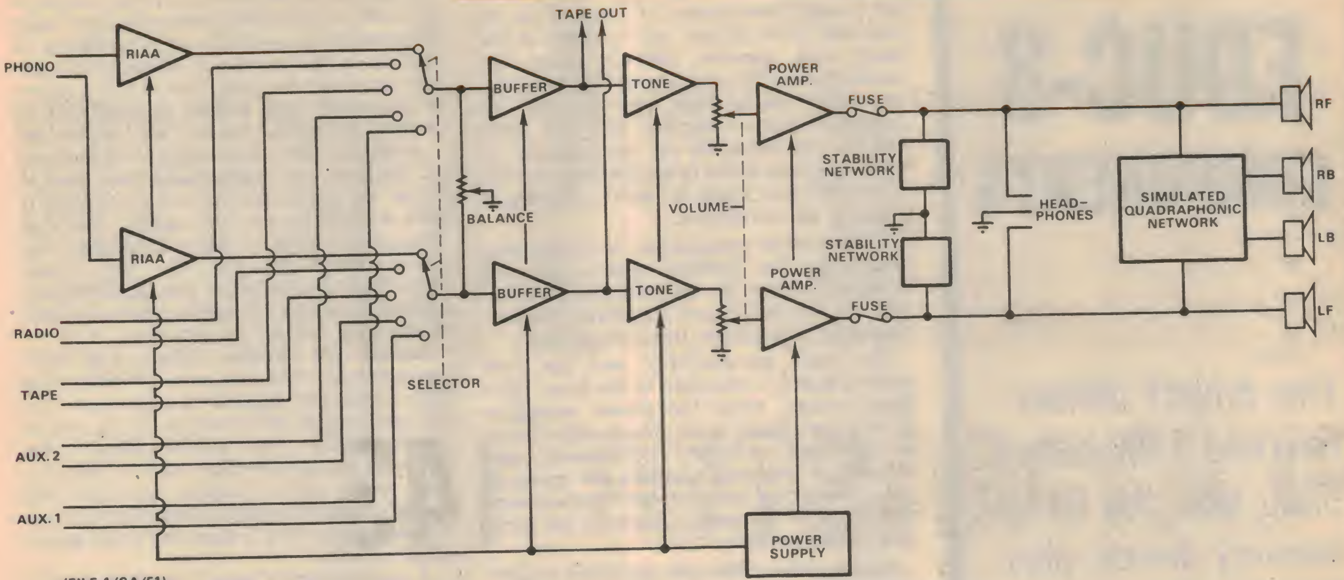
From the buffer stage, the signals are then processed by the tone control stages, pass through the volume control and thence into the power amplifiers.

The output from the power amplifier is passed through a fuse to a stability network. This consists of a 15 ohm resistor in series with a 0.47uF capacitor placed across the load to inhibit any possible instability due to loudspeaker reactance.

The next component in the signal chain is the headphone socket. This is the type incorporating a fully isolated double-pole double-throw switch which is operated whenever a jack is plugged into the socket. We have wired this so that when the headphones are not plugged in, the signal passes to the loudspeakers; when they are plugged in, the signal passes only to the headphones.

The quadraphonic simulator is situated after the headphone socket, so that all four loudspeakers are silenced when the

BASIC PLAN OF THE NEW AMPLIFIER



(FILE 1/SA/61)

The new Playmaster 143 is pictured at the top of the facing page. Externally, its appearance is similar to the Playmaster 136.

Because a full schematic circuit would be difficult to present and to read, our explanation of what the Playmaster 143 is all about is based on this simplified diagram. In particular, it shows the signal routing and switch functions involved in the various modes of operation.

The rear panel of the Playmaster 143. The signal inputs are at the rear left, whilst the loudspeaker outputs and fuses are at the rear right.

headphones are in use. The operation of this unit is best understood by referring to the accompanying circuit diagram.

Reduced to essentials, the idea involves connecting a second pair of loudspeakers in series between the active lines leading to the main speakers. This means that the additional loudspeakers receive what is basically a "difference" signal. The two additional loudspeakers are connected in anti-phase with the idea of blurring the apparent source of the sounds they produce.

While capable of creating a useful "ambience" effect, this arrangement does give a sound lacking in bass response, as on most stereo records the bass content is predominantly an in-phase component. A second disadvantage is that on mono signals, no sound at all is obtained from the rear loudspeakers — there being no difference component.

To partially compensate for this, we have provided a signal path for the rear loudspeakers back to the main signal return. This means that a mixture of sum and difference signals is fed to them.

The levels at which these components are radiated are determined by the values of the resistors in series with the loudspeakers, and by the value of the resistor forming the common path to the main signal return. Ideally, these resistors would all be variable, but this poses problems with respect to cost and availability of components.

We have compromised by using a special type of miniature toggle switch: a double-pole double-throw type with a centre "off" position. In the centre position, the rear speakers are disconnected, giving normal 2-channel stereo reproduction.

The other two positions are used to switch two sets of resistors into the circuit. In the "Ambience" position, two 22-ohm resistors are connected in series with the loudspeakers, and a 39-ohm resistor is connected in the signal return path. This gives a reduced signal level, and a small amount of bass content.

In the "Surround" position, no resistance is placed in series with the loudspeakers and a 10-ohm resistor is placed in the common return path. This gives the highest available level of difference signal with more bass content.

The values of these resistors may need to be altered to suit various types of loudspeakers. It is best to use sensitive types for the rear speakers, as this gives an effectively higher signal level which can be attenuated as necessary.

In general, this approach is most likely to be successful if situations where the rear loudspeakers can be placed fairly close to the listening position, though not necessarily directed towards it.

DC is prevented from flowing through the rear speakers by the use of two electrolytic capacitors. As these are effectively connected back to back, polarity problems are avoided.

We have used the same chassis shell as for the Playmaster 136, although many of the mounting holes required are different. In fact, our prototype was built on 136 chassis, which we re-drilled to suit. Proper chassis for the new Playmaster 143 should be available without too much delay.

The control panel is similar to that used with the Playmaster 136, the main differences being the addition of the headphone socket, and a slight re-arrangement of the power and four channel switches.

In order from left to right the controls are: power switch, quadraphonic switch, volume, bass, treble, balance and source. The headphone socket is situated immediately beneath the power switch. Reading clockwise from the left, the source switch positions are: AUX 1, AUX 2, TAPE, RADIO and PHONO.

The rear of the amplifier carries the fuses, the loudspeaker sockets and the input DIN sockets. We have not used a separate mono connector for the radio input, but instead a 3 pin DIN socket, which has been wired up for stereo. This means that if a mono signal is required to be reproduced from both channels, the input plug must connect to both input pins of the DIN socket.

For the phono socket, we have used a five pin DIN socket, wired up so that it is compatible with either a three pin or a five pin DIN connection cord.

Internally, the construction and layout is broadly similar to that of the Playmaster 136, although we have rearranged some of the component positions.

As will be evident from the photograph,

the power transformer is situated in the rear left hand corner, just in front of the fuses and speaker sockets. Note the orientation of the core, and the fact that the secondary output lugs face inwards. To minimise hum induction into the steel chassis, we mounted the transformer on brass spacers, using brass machine screws — an idea that might be worth applying to existing 136 amplifiers.

In front of the transformer is the tag strip containing the rectifier diodes and the dropping resistor for the pilot light. Next to this, to the right, are the three chassis-mounting electrolytic filter capacitors.

The main pre-amplifier and the tone control board is mounted in the front right hand sector, while the power amplifier boards are behind them. The quadraphonic components, stability components and headphone dropping resistors are mounted on a piece of tag strip fastened to the centre of the rear of the chassis, between the input and output sockets.

Construction of the new amplifier is quite straightforward, as most of the circuitry is contained on the three printed wiring boards. Two tag strips are used to hold the components of the power supply and the stability and quadraphonic networks. The remaining components are fixed direct to the chassis.

Commence construction by fitting the following components to the chassis: power transformer, filter capacitors, input and output sockets, fuse holders, potentiometers, and the source switch. For those components requiring mounting bolts, we used ⅛ inch machine screws and nuts. Alternatively, "pop rivets" could be used, although these are of a more permanent nature, and do not permit easy disassembly if this is required.

The power transformer must be mounted on brass spacers using brass nuts and bolts. The spacers should be about 10mm long, in order to provide approximately the same clearance at the top and bottom of the transformer.

The 240V AC wiring can now be completed. The mains cord enters the chassis through a grommeted hole at the rear, and is securely anchored using a suitable clamp. The active and neutral wires are terminated at a small insulated terminal block. The earth wire is threaded through, and soldered to a solder lug attached to the cord clamp.

Regular lamp cord or suitably insulated twisted hookup wire runs from the terminal block to the miniature toggle switch, and from the terminal block to the primary of the transformer. The exact connections at the terminal block are shown in the wiring diagram.

Once the connections have been made and checked, a wise safety precaution is to tape the primary connections to the transformer and the power switch, as these points are possible shock hazards. Two or three layers of insulating tape should be sufficient to prevent accidental contact with the mains.

Assemble the power supply components on the tag strip, taking particular care to mount the diodes correctly. The tag strip is held in place by a metal spacer, which, in conjunction with a solder lug, forms the chassis earth for the two RF bypass capacitors. Do not forget to scrape the paint from underneath the spacer and screwhead where they contact the chassis.

Loosen the clamps holding the filter capacitors so that they may be rotated in their bases, and align them as shown in the wiring diagram. The two nearest the rear of the chassis have their positive leads facing the right, while the third has its negative lead facing right. Connect the three left hand terminals together with heavy gauge tinned copper wire to form the main power supply earth.

A second piece of wire is used to connect the two positive terminals of the two capacitors nearest the rear of the chassis to form the positive supply rail. The negative supply point is the unattached terminal of the third capacitor.

The wiring from the transformer to the tag strip and from the tag strip to the filter capacitors can now be completed, along with the wiring to the pilot light. The pilot light, in series with a 470 ohm 1 watt resistor is wired across the negative supply rail. This also serves to discharge the capacitor. A 2.2k resistor serves the same purpose on the positive capacitors, being wired directly across the capacitor terminals.

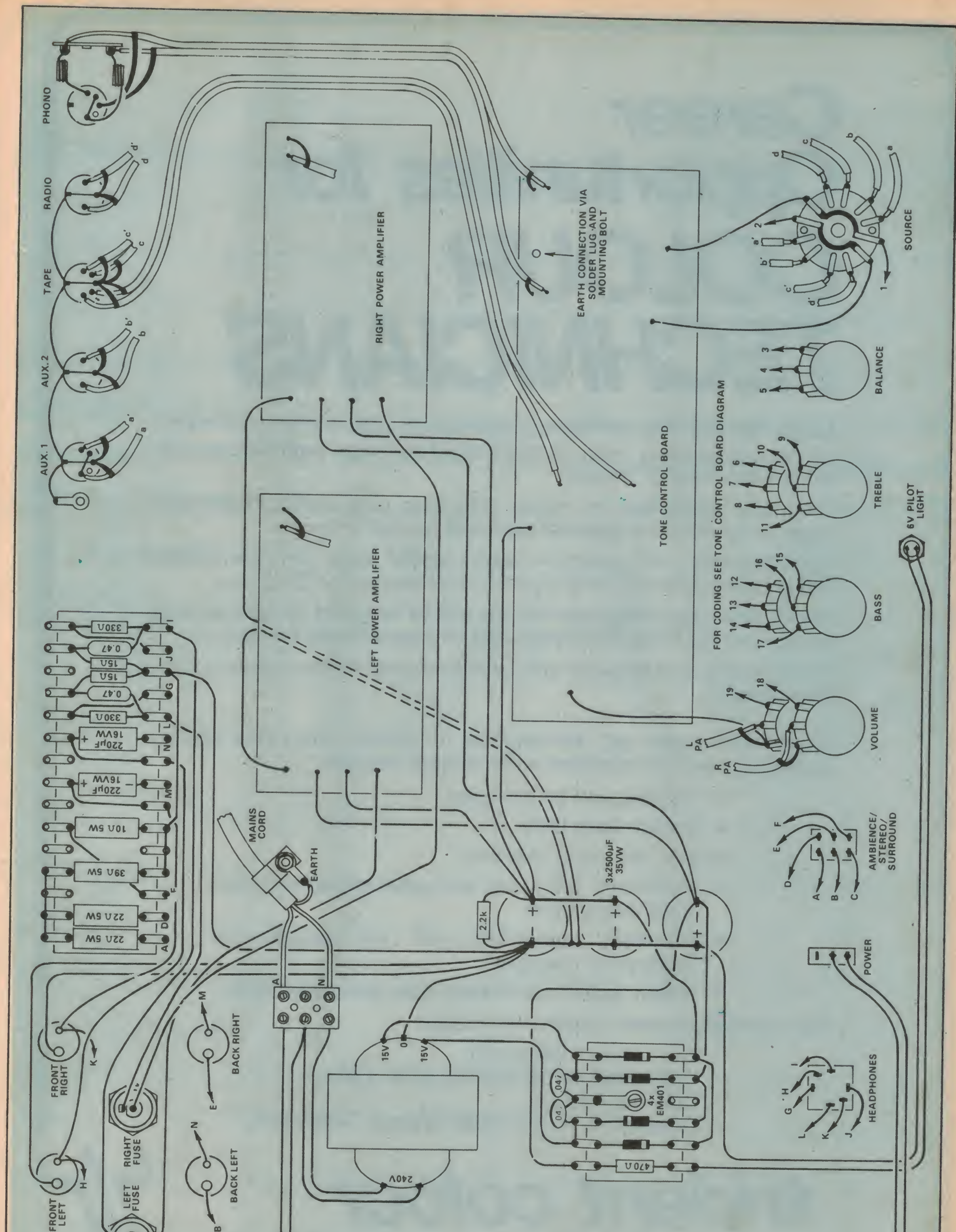
The next stage in construction is to make the connections between the input sockets and the source switch. This wiring is concerned only with the two auxiliary inputs, the tape input and the radio input. We will discuss the wiring of the phono input at a later stage.

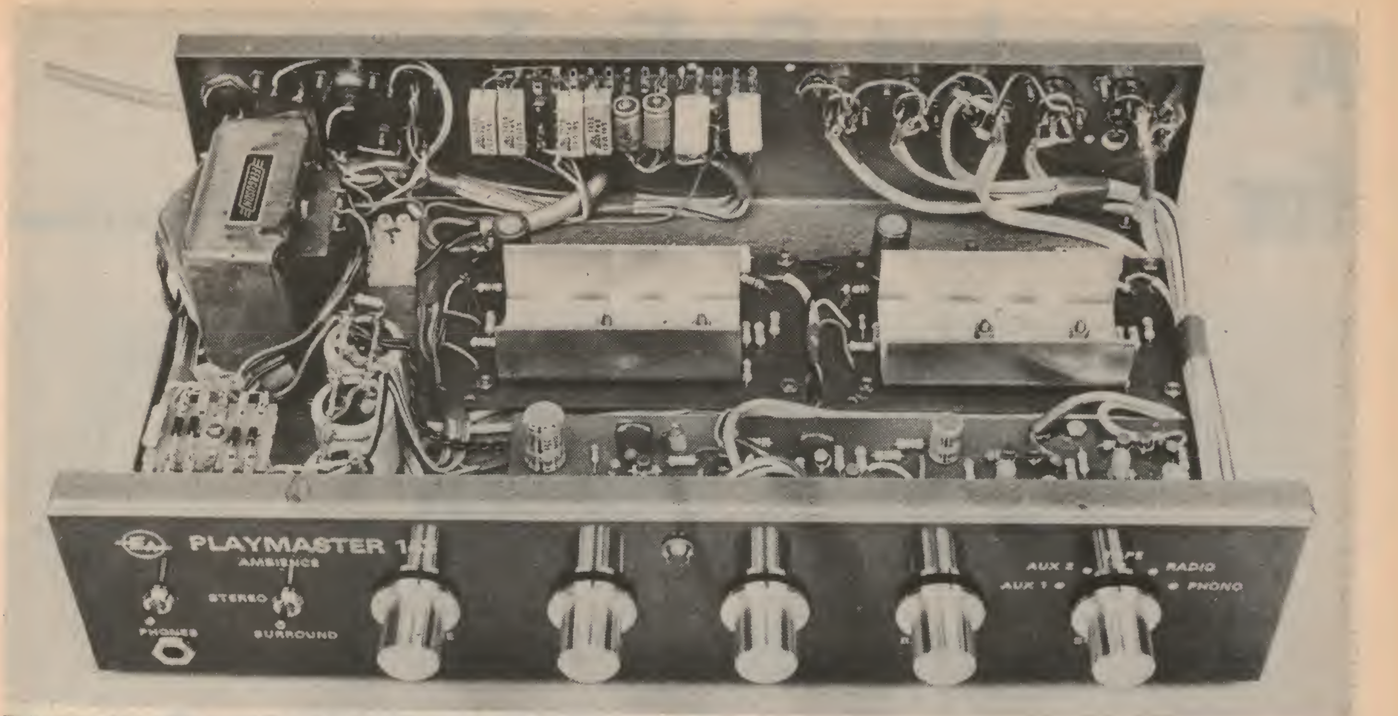
First of all, connect pin 2 and the shell connection of each socket together. (A cut off component lead makes an economical and easy to obtain wire.) Then join each of these together with short lengths of hookup wire, and then to a solder lug attached to the

The diagram on the facing page should be invaluable when you actually constructing the new amplifier. It shows details of the input and switch wiring and the loudspeaker, phones and power supply connections. Pay particular attention to the earth wiring sequence when constructing your amplifier.

SPECIFICATIONS

Power Output)8 ohms): 16.5W RMS with one channel driven: 12.5W per two channels driven;
Frequency Response: within +2 and -2dB from 20Hz to 20kHz with tone controls at approx centre. Power amplifiers flat to 60kHz, then deliberately rolled off.
Compensation: RIAA for phono input. Other inputs flat.
Sensitivity: Magnetic phono, 2mV into 50K nominal for 15W RMS output. Other inputs, 150mV into 500K nominal.
Signal / Noise Ratio: Better than 60dB for all inputs, tested with input circuits open.
Cross-Talk: Better than 44dB at 1kHz for all channels with typical sources connected to the inputs.
Distortion: THD at 1kHz and max rated power 0.6pc At typical listening levels (inc noise component) 0.4pc.
Bass, Treble Controls: Nominally +14dB and -18dB at 50Hz and 10kHz.
Stability: Tested and stable into capacitance values across load up to 2uF.


PHONO
RADIO
TAPE
AUX.2
AUX.1
RIGHT POWER AMPLIFIER
LEFT POWER AMPLIFIER
EARTH CONNECTION VIA SOLDER LUG AND MOUNTING BOLT
TONE CONTROL BOARD
FOR CODING SEE TONE CONTROL BOARD DIAGRAM
SOURCE
BALANCE
TREBLE
BASS
VOLUME
6V PILOT LIGHT
AMBIENCE/ STEREO/ SURROUND
POWER
HEADPHONES
MAINS CORD
EARTH
3x2500µF 35VW
2.2k
4x EM401
470Ω
.047
.04
15V
0
15V
240V
330Ω
0.47
15Ω
220µF 16VW
10Ω 5W
39Ω 5W
22Ω 5W
FRONT RIGHT
FRONT LEFT
RIGHT FUSE
LEFT FUSE
BACK RIGHT
BACK LEFT
L PA
R PA



This view shows the complete chassis with all modules in place.

chassis by the mounting screw of the AUX 1 socket. This will ensure a good earth connection for the inputs.

The signal is carried from the input sockets to the source switch using figure-8 shielded wire with outer PVC covering, to prevent random contact between the shield and the chassis.

It is absolutely essential to follow the earthing procedure suggested in the diagram. Failure to do so will almost certainly result in hum problems and possible instability as well.

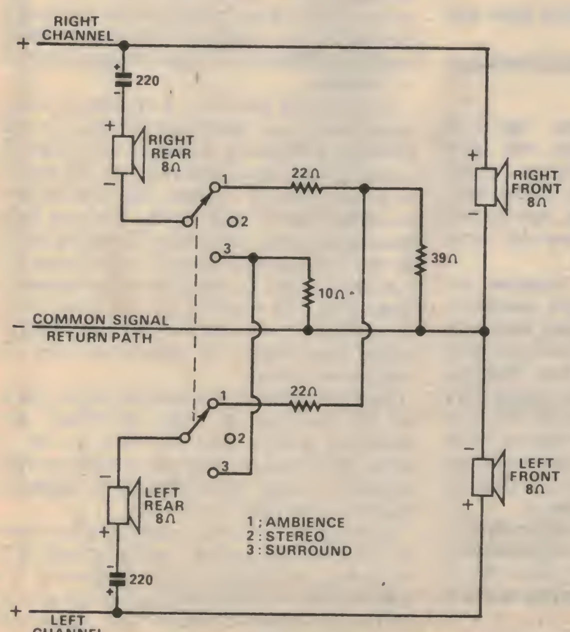
The braids of the cables are connected to pin 2 of the respective sockets, while the inner conductors are soldered to their respective pins. Refer to the wiring diagram for details of which pins are used. If the cable comes with inner conductors which are colour coded, i.e. with red and white insulation, follow a suitable convention with respect to the connections, such as "red equals right".

If your cable is not colour coded, use coloured insulating tape or a scrap of PVC sleeving to mark the inner conductors. This is best done by using say red tape for the right channel, and marking both ends of the conductor before soldering the cable into position.

At the source switch end of the cables, no connection is made to the shield. Only the inner conductors are soldered to the switch, the braids being cut off short and insulated with the coloured tape or sleeve already mentioned. Refer to the wiring diagram for details of the connections to the switch. Once all connections have been made, the four stereo cables may be taped or bound into a single cable, using either nylex tubing or insulating tape, and tucked down into the angle of the chassis.

For the phono socket, pins 1 and 5 are bridged, allowing either a 3-pin or a 5-pin DIN plug to be used. Do not make a connection between pin 2 and the shell connection of the socket. Two small RF chockes made from ferrite beads and a small length of thin enamelled copper wire are placed in series with the input leads immediately adjacent to the socket.

These chokes, intended to combat radar and other RF interference, are made from 3.5mm diameter and 5mm long ferrite beads by winding about 5 turns of 28 B & S gauge wire, or similar, through them. One end of each choke is anchored to pins 3 and 5 respectively, while the other ends are terminated on a small piece of tag strip secured to the socket mounting screw. This also serves as the termination point for the shielded cable leading to the magnetic preamplifier board.



At left, the quadraphonic simulator circuitry. Essentially, this circuit is based on the Hafler / Dynaco configuration in which a "difference" signal is fed a second pair of loudspeakers. However, in this circuit we have also provided a signal path back to the main signal return in order to compensate for what would otherwise be a poor bass response. This means that a mixture of sum and difference signals is fed to the rear loudspeakers.

The next step in construction of the amplifier is to assemble the simulated quadraphonic and stability components onto the 15-pair tag strip. First place in position all the straps, as shown on the wiring diagram. Do not forget to insulate these to prevent short circuits. Once this has been done, the resistors and capacitors may be added.

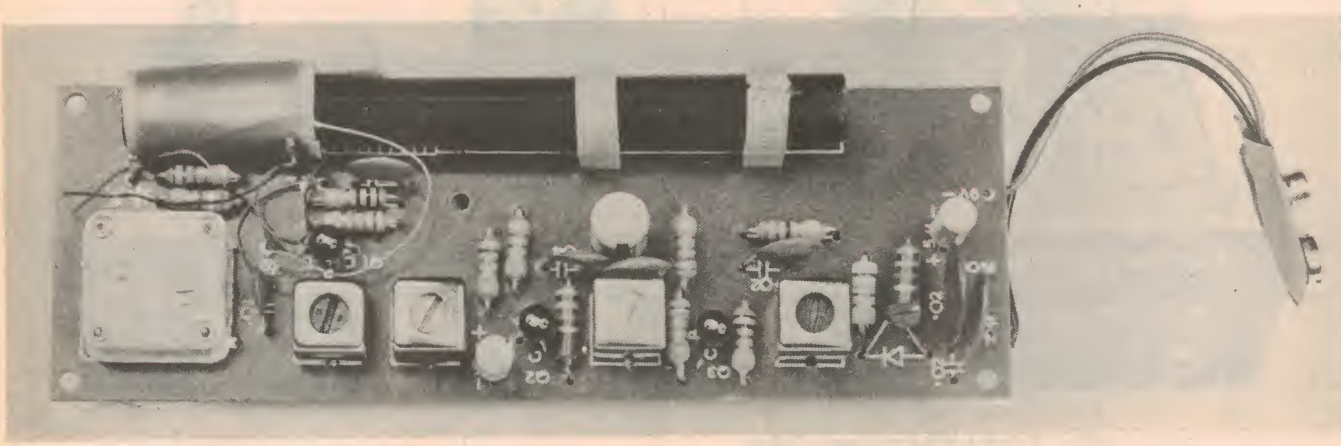
The next job is to make up and fit the wiring harness for the headphone socket and the ambience/stereo/surround switch. This runs from the tag strip at the rear of the amplifier behind the transformer and up the side of the chassis to the relevant components at the front. A branch runs from behind the transformer up to the speaker sockets and the fuse sockets.

Using the chassis as a guideline, and using multicoloured wires, make up this harness before installing it. Take care that no mistakes are made, as this could lead to expensive damage, particularly to the output transistors.

(To be continued.)

A Superhet Radio Tuner for less than $8

by NEVILLE WILLIAMS



A top view of the tuner, reproduced almost full size. Note the wedge holding the aerial coil in place, at least temporarily. A blob of wax would hold it more reliably. Normal supply is 9V at about 2mA.

Here's a project that should be of special interest to those who are in the market for a small superhet tuner, whether to receive broadcast stations directly or to serve as an IF system for a converter. A few dollars and a couple of hours work will bring you the tuner; as pictured.

It so happens that we've been thinking for some time about producing a radio tuner which would be simple, cheap and appropriate for use ahead of amplifiers and tape recorders. We had an open mind as to whether it should be a superhet design, a TRF or an amplified crystal set! Also whether it should use discrete components or one of the new front-end integrated circuits.

But we soon found ourselves in a bind. Any circuit that promised reasonable all-round performance turned out not to be cheap. Conversely, anything cheap was obviously bound to have severe limitations.

It was at this point that Dick Smith of Dick Smith Electronics showed us a superhet tuner kit he had brought back from Hong Kong. They could be imported and sold for not too many dollars. Would we be interested?

Well, we took the kit home and looked in dismay at the sparse information — much of it in Chinese anyway! But we worked out how the rod antenna and transistors must go, and were fortunate to come across some other data which gave us a possible clue as to which of the IF transformers was which. After this, a couple of hours work was all that was necessary to complete it.

The job done, we connected it to an amplifier and a 9V battery and hopefully turned the dial. We got nothing but a few whistles, and it seemed that the tuner was hopelessly unstable. Further fiddling showed that it was, but mainly because we had the aerial coil pushed down near the centre of the rod. This appeared to inhibit the mixer/oscillator from functioning, while encouraging oscillation around the IF system as a whole.

When we shifted the aerial coil to the extreme end of the rod, the tuner started to come good. Using a dip oscillator to couple signal into the aerial, we peaked the IF transformers first, then the oscillator and aerial cores and trimmers.

This done, the tuner behaved in much the same manner as a typical oriental transistor portable receiver: adequate sensitivity and all-round performance, with the one limitation that it tended to overload on very strong signals, as from a nearby broadcast transmitter.

But more of that anon.

At our suggestion, Dick Smith flew out another kit and we followed the same procedure with the same end results. This encouraged us to think that they might be consistent.

It also encouraged Dick Smith to place an order for a substantial number of kits, with the intention of making them available for as long as possible through those suppliers prepared to handle them.

As received; the kit contains only the "works" of a tuner, for assembly on to a printed board (supplied) measuring 45 x 135mm. There is a mounting hole in each corner but no other provision for housing it. Tuning is by a simple 31mm thumb wheel, roughly calibrated in figures suggesting 530 — 1600kHz.

We debated the idea of finding a larger round dial, or a slide mechanism, or substituting altogether a larger air-dielectric tuning gang. We considered also the matter of a non-metallic cabinet, the provision of an off-on switch and so on. But one thing became obvious: the cost of dressing up the tuner could exceed the cost of the basic kit!

Added to this, it would be superfluous for those who may want to use the tuner as an IF system for a converter. In this event, it would most likely be associated with the converter module.

So we are simply presenting the kit, as is, on the assumption that individual constructors will be able to house it and/or dress it up to suit their own requirements, hopefully using initiatives and oddments that will not cost too much.

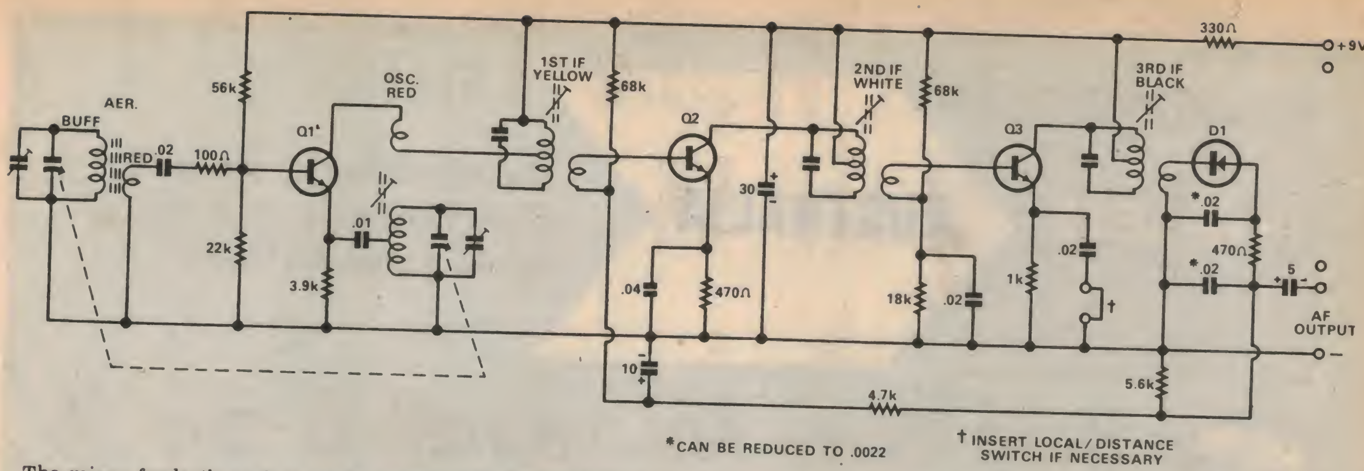
Turning to the circuit, tuning is by means of a miniature 2-gang capacitor with PVC dielectric and in-built rotary timmers. The gang tunes a conventional rod-aerial coil, and a miniature oscillator coil associated with a self-oscillating mixer.

ABOUT THIS PROJECT:

Lowered tariff barriers have made it possible for suppliers to import not only cheaper components and built-up equipment, but project kits as well. Some kits, such as the one featured here, are so attractively priced that constructors will want to take advantage of them.

There is a catch, however. Because the kits are designed and packaged overseas, they have to be accepted at face value, in terms of quality, performance and associated data. Components may change, or the kit may be discontinued, depending entirely on circumstances overseas. What is more, while we have done our best to fill in the gaps of very sparse original data, we are not in a position to discuss the unit beyond what is contained in this article.

But, in the meantime, it is available now at a very attractive price. The two samples which we constructed worked okay. So, if you want one, take the opportunity while it is there.



The circuit of the tuner, originally branded "Bushkit" but redrawn here in the E.A. style. If you want to operate the tuner close to a powerful station, you may have to break the earth return lead of the emitter bypass for Q3, and insert a switch for a "local-distance" function. No provision is made for this in the original design.

The mixer feeds through a single tuned miniature IF transformer to an AGC controlled IF amplifier. This is followed by a second IF transformer and IF amplifier, operating at fixed gain, which feeds into a conventional diode detector, cum AGC source.

The transistors are all NPN silicon types devoid of any brand or type number. We suspect that they are devices which have fallen outside formal specifications but which have been selected as suitable for this particular tuner.

In the first kit to hand, the three transistors were of glob-top construction, each with a blue spot on top. We assumed that they could be used in any of the three positions. In the second kit, one transistor had been pushed into the board in the mixer position and the leads bent over — an apparent hint that this was the one to be used there.

For the diode detector, the original kit had an unbranded TO-92 pack transistor, with one lead clipped off. There was a blue spot on the anode side but whether this was intentional or accidental was not obvious. We connected the centre lead as the anode and the remaining outer lead as the cathode, and this was obviously the proper way to do it. On the other hand, the second kit included a regular diode.

A point of note is that the RF bypass capacitors supplied for the diode RF filter circuit are each .02uF, which is sufficiently large to filter out a good deal of the audio treble response as well! It wouldn't matter if the tuner were intended to feed through a miniature amplifier to a miniature loudspeaker, but the attenuation would be far too severe for any situation with a pretence to quality. We substituted .002uF capacitors for the original values without encountering any bother with RF instability.

The AGC circuit involves a 68k resistor from the supply line to the base return of transistor Q2. From this point 4.7k and 5.6k resistors in series run to "earth," the junction of the two providing the return point for the diode detector circuit.

In the absence of signal Q2 is biased on for normal stage gain, while the small positive voltage at the diode return point brings it to the point of conduction. With signal, the diode generates a negative voltage which progressively reduces the base current and gain of Q2.

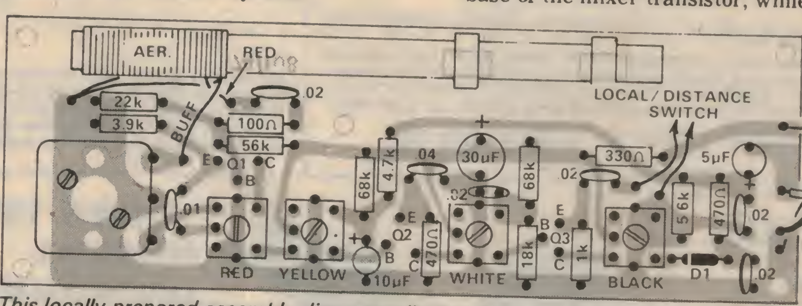
Construction is simplified, for the most part, by having the position and value of components printed on the surface of the board in white ink. There should be no problem with the resistors and capacitors, which are familiar components. Just watch the polarity of the three electrolytic capacitors.

We also picked up an error on the two boards we had: the connection for the battery positive lead was shown as "—9V", whereas it should have been "plus 9V". The —9V lead should connect to the copper pattern through one of the two holes adjacent to the "earth" symbol.

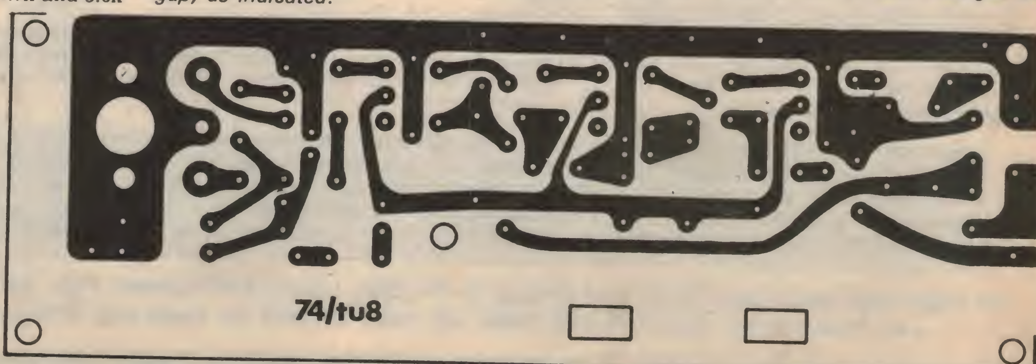
The other earthy hole is for the braid of the signal output lead, the centre conductor going to the hole marked "out."

What the kit doesn't seem to make clear is the colour coding which identifies the oscillator coil and the three IF transformers. By inference from an entirely different source, we identified the oscillator coil as the component with the top of the core painted red. The IF transformers were as follows: IFT1 — yellow; IFT2 — white; IFT3 — black. Connections are not a problem, since the units will fit into the board in only one way.

There was also something of a problem with the aerial coil, probably because we could not read the Chinese characters which may have given a clue to the colour coding of the leads. After identifying the windings by measuring their resistance, we connected the leads which were stained respectively black and green to earth via the hole so marked. The red lead goes through the .02uF coupling capacitor to the base of the mixer transistor, while the buff



This locally prepared assembly diagram will fill in a few of the details not obvious from the original kit board. If you need to fit a local-distance switch, not provided for in the original pattern, it will be necessary to cut the copper track and wire the switch so that it bridges the gap, as indicated.



Here is a close copy of the original wiring pattern, modified to include a local-distance switch. If, at any time, the "Bushkit" ceases to be available, there is the possibility that parts could be obtained separately to construct a similar tuner on this board.

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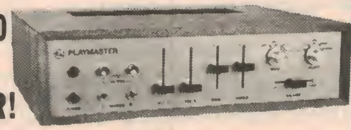

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SUPERHET TUNER

coloured lead goes to the tuning capacitor.

The dial scale can be fixed to the tuning gang shaft in either of two positions. The most logical is with the gang turned fully anti-clockwise and the figures towards the adjacent end of the board. This way, a small spike can be attached to the earthy pattern to provide an indicator against which the dial can be read.

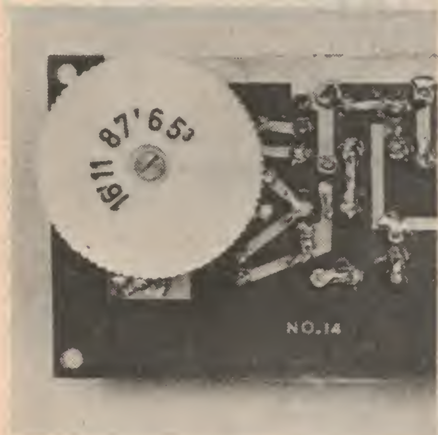
With the construction complete; it remains only to connect the tuner to a 9V battery and an amplifier and to peak it up for best performance. (Current drain is about 2mA). Slip the aerial coil on the rod with the connections innermost but, as hinted earlier, keep it right to the end of the rod.

If you have a signal generator on hand, couple the output very loosely to the mixer input via a very small capacitor or by clipping the lead to the body of the .02uF disc ceramic. In fact, we used a dip oscillator which was positioned to feed a 455kHz signal directly into the loopstick aerial coil, without a physical connection.

Peak the IF transformers for maximum response at 455kHz.

Now turn the tuning capacitor fully anticlockwise, as viewed from the dial face; this is the 530kHz setting. By adjusting the signal source and the oscillator core, set the tuner to receive 530kHz at the fully closed position of the capacitor, or 550kHz with the capacitor just short of being fully closed.

Juggle the aerial coil along the rod for maximum sensitivity and, if necessary, hold it in place by jamming a matchwood



The knurled tuning knob on the copper pattern side of the printed wiring board.

sliver be-tween the former and the core.

Now turn to the other extreme of the dial and bring a 1600kHz signal to calibration with the oscillator trimmer — the one furthest from the oscillator coil. Peak the aerial trimmer for maximum sensitivity. Having done this, repeat the operation to absorb any interaction there may be between the core and trimmer settings.

If you have a reason to do so, the tuner can readily be adjusted to bring in Sydney's radio university station just beyond the top end of the normal band.

If no signal source is available, select an identifiable station towards the low frequency end of the band and bring it to its calibrated position by means of the oscillator core. Slide the aerial coil along to establish its peak and wedge it in position.

This done, tune to a weak station still at the low frequency end and peak the three IF transformer cores for maximum sensitivity.

Now select an identifiable station at the high frequency end of the band and bring it to its proper position on the tuning scale by means of the oscillator trimmer. Next, select an adjacent weak station and peak the aerial trimmer for maximum sensitivity. This done, re-check the aerial coil position on a low frequency station and the aerial trimmer on a high frequency station.

In conclusion, two points should be mentioned about signal level. In an ordinary location, away from the shock area of a strong station, the tuner's AGC will cope with likely variations in signal strength without overload. The signal from the detector should be suitable for the "tuner" or "auxiliary" input of most amplifiers, being about 100mV RMS.

In rare cases, it may be necessary to insert a preset pot (say about 50k) between the tuner and amplifier and adjust the pot for a suitable signal level into the amplifier.

The other point is that, very close to a powerful station, the tuner itself may overload due to the fact that it has only one stage controlled by AGC. The gain can be reduced drastically by opening one lead of the .02uF emitter bypass of the second IF amplifier. In the unlikely event of that begin not enough, the bypass can be disconnected also from the emitter of the preceding stage.

Since the effect of this modification might render the tuner too insensitive on weaker stations, an obvious possibility is to wire a switch in series with the .02uF emitter bypass, to serve as a local / distant switch.

RCA develops clutter-free anti-collision car radar

Anti-collision radar systems for cars have been talked about for years, during which time several developmental units have been demonstrated with varying degrees of success. However, the problems encountered in developing a unit suitable for everyday driving conditions are formidable, and conventional units have suffered from a host of interference problems. This article discusses these problems, and describes an interference-free anti-collision radar recently developed by RCA.

by J. SHEFER, R. KLENSCH, G. KAOLAN, and H. JOHNSON*

During 1970, in the USA, there were 12.3 million collisions involving two or more vehicles. Of this number, 3.8 million, or close to one-third, were rear-end collisions. It is apparent then, from these figures, that an anti-collision radar system would make a significant contribution towards reducing the accident rate.

A viable anti-collision radar for cars on highways must first be immune to clutter. This includes reflections from the roadway, trees, highway signs, overpasses, bridges, and similar highway fixtures. The seriousness of clutter can be assessed when it is recognised that the radar cross-section of an overhead sign can be 30dB larger than the radar cross-section of the back of a small car.

Conventional anti-collision car radar systems have tried to cope with this problem by excluding any returns from objects that are stationary with respect to the ground. That kind of processing does eliminate clutter from stationary objects. Unfortunately, it also eliminates the return from a vehicle standing in one's own lane and this is a serious deficiency, especially since the majority of rear-end collisions occur at a time when the car in front has completely stopped.

When we add to the picture a large number of cars carrying the same kind of radar and travelling in both directions of a highway, a whole new family of mutual interference problems arises. These can be characterised as blinding, masking, and cross-talk types of interference, and can cause false alarms or mask true alarm situations in conventional radar systems. Minimising the incidence of false alarms is of prime importance if automobile radar systems are ever to become a reality. When false alarms have a very low threshold level, users are likely to lose faith in the system and either override it or shut it off completely.

RCA Laboratories in the United States have recently developed a clutter free radar system that will aid the driver in maintaining a safe distance from the car in front by constantly monitoring the distance and the closing rate between the two vehicles, as well as monitoring the driver's own ground speed. The driver will be warned by sound or light signals whenever the combination of these parameters indicates that the separation between his car and the car in front becomes unsafe. A further step in the system's development would include an automatic braking system and, eventually, an automatic throttle control could be added for completely automated headway control.

The basic concept of the RCA system is illustrated in Fig. 1. A completely passive reflector, mounted on the back of vehicles returns the second harmonic of the frequency transmitted from the following vehicle. This radar is immune to clutter, since the receiver in the trailing vehicle is tuned to the second harmonic frequency only. Extensive testing has so far failed to reveal any natural or man-made objects that will unintentionally produce a detectable second harmonic frequency.

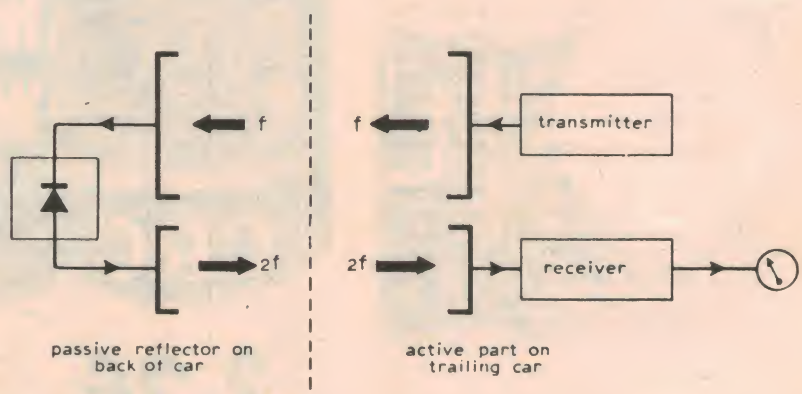


Fig. 1. Harmonic radar configuration.

The RCA radar concept will also eliminate blinding interference effects from oncoming vehicles. Fig. 2 illustrates the problems caused by blinding in a conventional radar system. Car A in Fig. 2 is travelling behind car E, with its conventional radar measuring the distance to car E. Car D, going in the opposite direction will deliver an enormously large signal to car A's receiver, compared with the reflection from car E. Quantitatively, the blinding signal can be 50-60dB higher than the signal required. This blinding transmission will therefore be seen from a long distance ahead and may cause a false alarm, as well as saturating the receiver of car A. The side lobes from cars B and C may have the same effect. In the RCA system, however, this blinding signal is eliminated since the receiver of car A will reject all signals other than the second harmonic of its transmitted frequency.

Indicated in Fig. 3 is another kind of interference inherent in conventional anti-collision radar systems: cross-talk interference. Car C in Fig. 3(a) may receive a false alarm from car B in the adjacent lane, even though there is no danger of it running into car B. With the harmonic radar system, this problem is eliminated as the return signal is shaped into a well-defined narrow beam covering the width of one lane only, as shown in Fig. 3(b).

Fig. 4 demonstrates another potential cross-talk interference situation that may occur when two cars in adjacent lanes are negotiating a curve. In Fig. 4(a), the widely scattered return from car B will cause a false alarm for car A when a conventional radar is employed. Once again, this problem is eliminated (Fig. 4(b)) by employing a narrow beam harmonic radar system.

Illustrated in Fig. 5 is yet another problem inherent in a conventional radar using the car's body as the reflector. Radar cross-sections of the rears of cars can vary tremendously: the back of a lorry may have a radar cross-section several hundred times larger than a small car. This results in a type of interference known as masking, whereby the desired return from a close vehicle is obscured by the return from a much larger vehicle further down the road.

* RCA Laboratories, New Jersey.

However, with the RCA harmonic radar system all radar cross-sections, or reflectors, are the same, unless designed otherwise, thus eliminating any problems due to masking. Furthermore, if all reflectors are mounted at a standard height, only the nearest reflector will be "seen" while all others will be obscured.

The success of the harmonic radar concept was critically dependent on developing an efficient, passive harmonic reflector, ie, finding a solid-state device which, in a suitable circuit, would generate the second harmonic with the required efficiency. For a car radar application, it was felt that the reflector must be completely passive, with no wiring to the car's electrical system in order to ensure reliable operation.

The above needs have been met by a silicon Schottky diode mounted in a microstrip circuit, as shown in the photograph. Input at X-band is coupled at a voltage maximum point of the fundamental frequency, while the output is coupled at a voltage maximum point of the second harmonic, with a quarter wavelength open section coupled to the output line to reflect the fundamental frequency back into the circuit. A similar doubler circuit is used to provide a sample of double the frequency transmitted to the local oscillator port of the receiver mixer.

A block diagram of the RCA harmonic radar system is shown in Fig. 6. CW power at X-band is generated by a varactor-tuned transferred-electron oscillator (teo) modulated at a rate of fm by a triangular waveform with a total frequency excursion of delta F, as shown in Fig. 7. The frequency swept power is radiated from antenna A1 mounted on the front of the trailing car (see Fig. 6), and impinges on a similar antenna A2 which forms part of the harmonic reflector mounted on the back of the car in front. The passive doubler generates the second harmonic frequency of the power incident on antenna A2 and radiates it back to the trailing car via antenna A3. Receiving antenna A4 then delivers this received frequency to the mixer, where it is mixed with a sample of double the transmitted frequency.

The returned signal differs in frequency from the second harmonic of the transmitted frequency due to the round trip time delay $T = 2R / c$, where R is the distance between the two cars and c is the velocity of light. The difference frequency, fr, is represented by the equation: $fr = 8R\ (\text{delta } F \times fm) / c$.

By calculating the frequency difference, we can calculate the range, since the time delay is proportional to the distance between cars.

Two different techniques for measuring this frequency difference have been investigated. The first, for which the bulk of experimental work has been carried out is described below. The second technique is much more complex and is beyond the scope of this article.

In the first technique, the following modulation parameters are employed: frequency excursion at X-band is 25MHz, whilst the modulation frequency is 3kHz. For the parameters chosen, the frequency versus range slope is 2kHz / m, resulting in a 10kHz-200kHz range in the difference frequency as the distance varies from 5 to 100 metres.

The output of the mixer is amplified, filtered and then fed into a counting circuit. This counting circuit develops a voltage

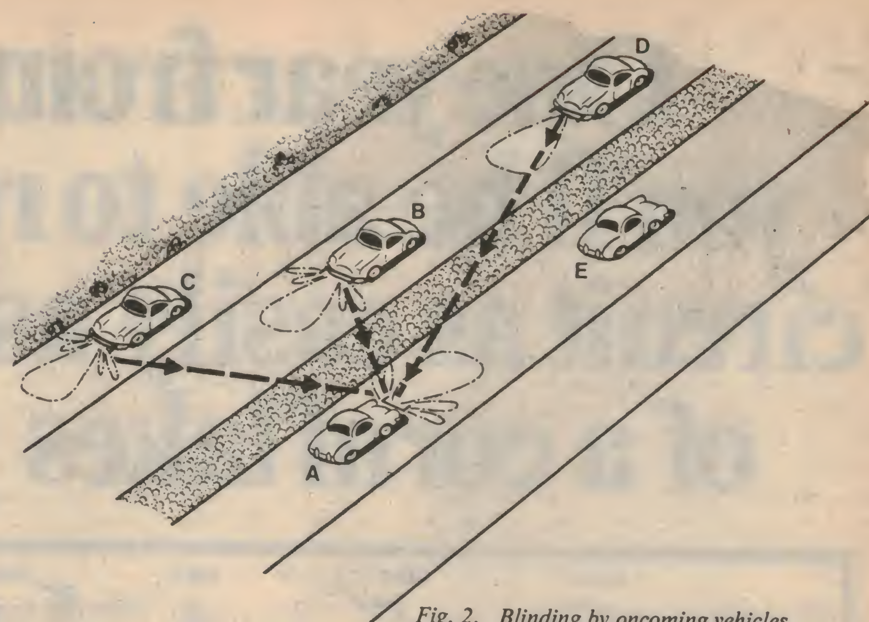


Fig. 2. Blinding by oncoming vehicles.

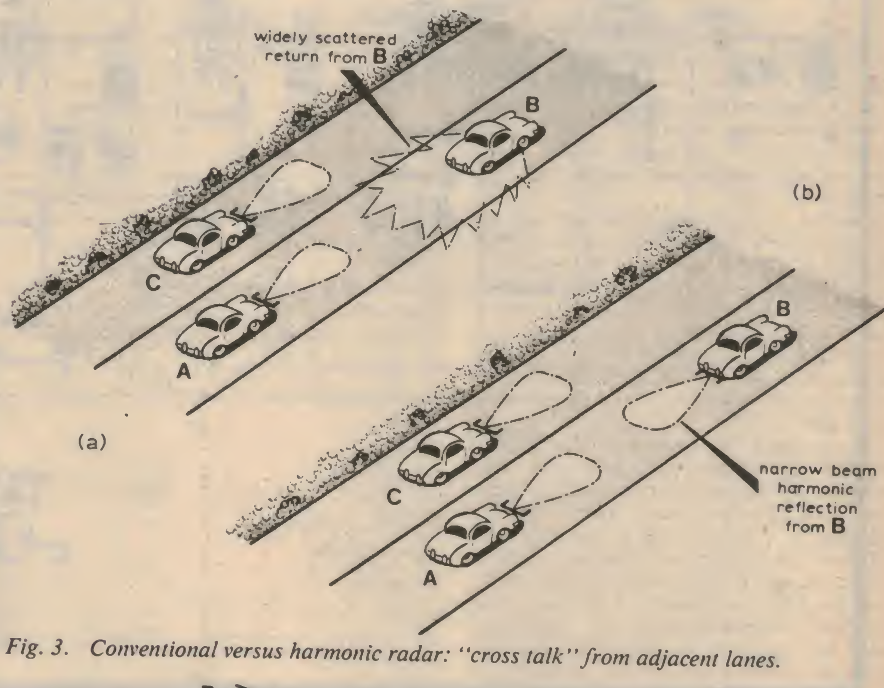


Fig. 3. Conventional versus harmonic radar: "cross talk" from adjacent lanes.

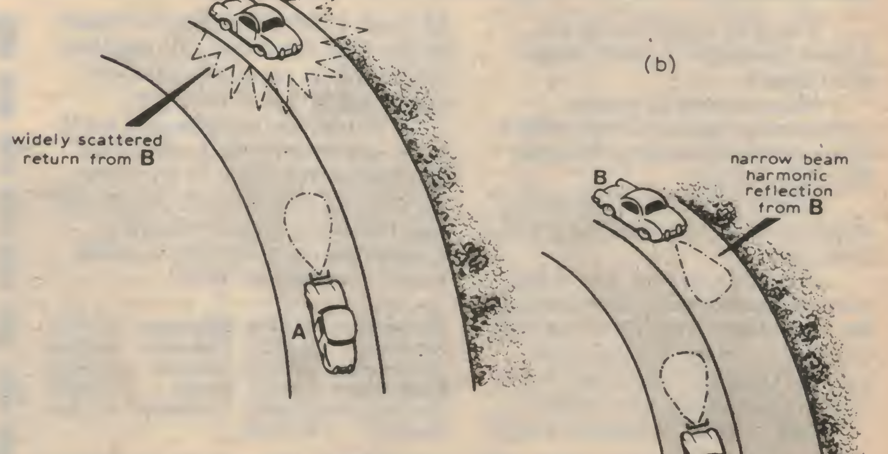


Fig. 4. Conventional versus harmonic radar: road curves.

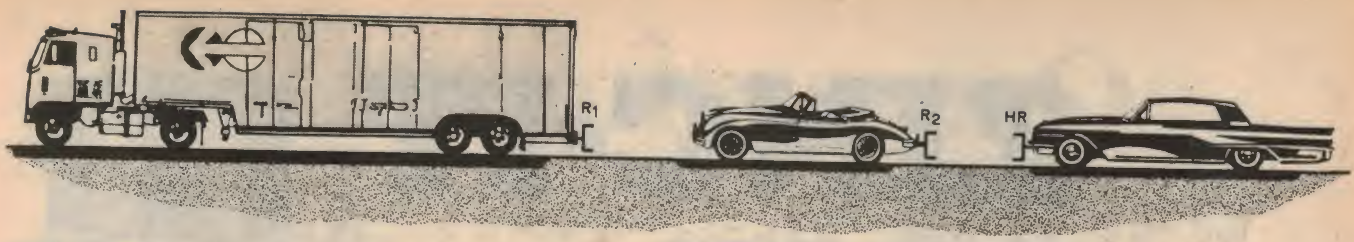


Fig. 5. Conventional versus harmonic radar: masking.

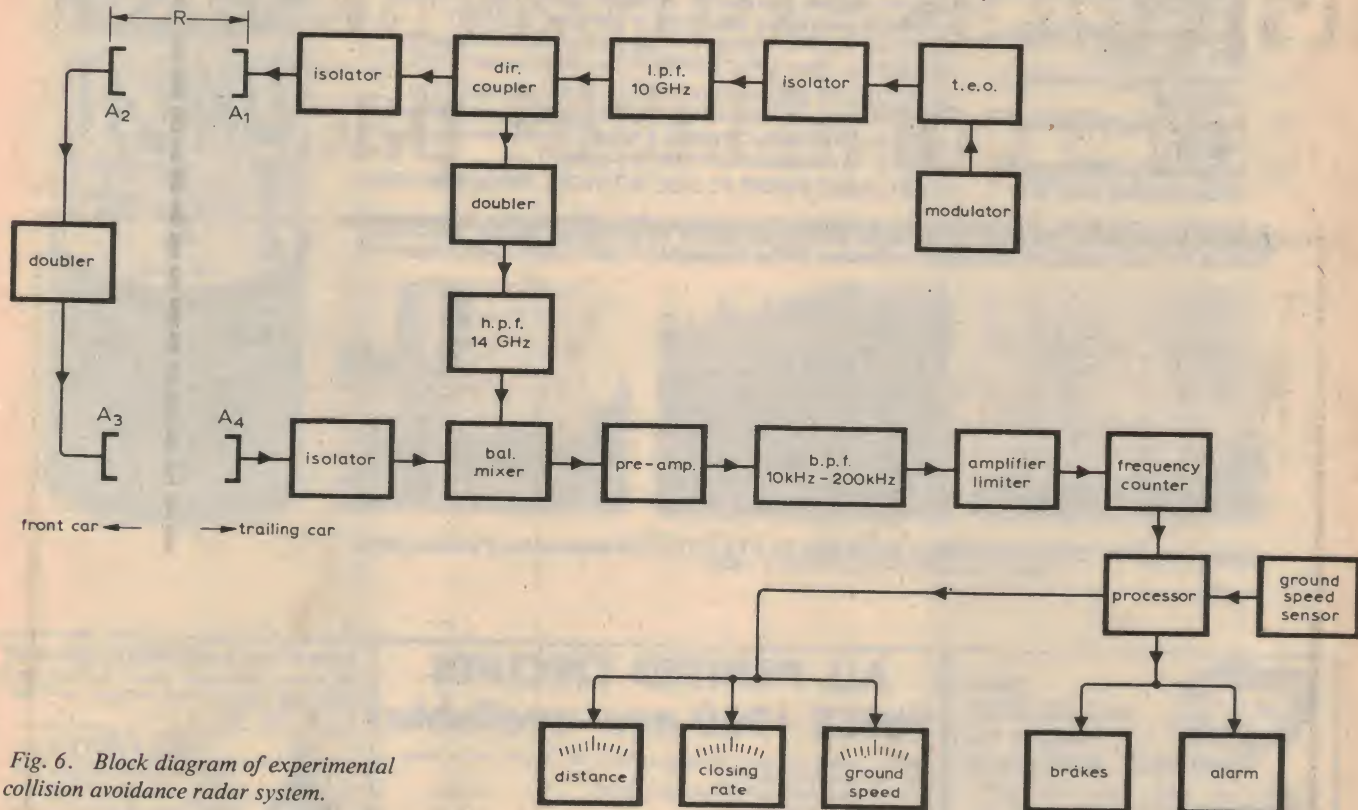


Fig. 6. Block diagram of experimental collision avoidance radar system.

which is proportional to the rate of zero crossings of the input signal and therefore the range. In addition, the radar processing circuitry derives a voltage which is proportional to the first derivative of the range, thus yielding the closing rate.

In order to make a decision as to what represents a "safe distance" between vehicles, a third piece of information — the ground speed of the vehicle — is required. The ground speed is derived from an independent microwave Doppler speed sensor. The radar processor combines the three measurements of range, closing rate and ground speed in a predetermined fashion, depending on the criteria chosen for a "safe distance." This is, of course, dependent on weather and road conditions.

When a dangerous driving situation is encountered, an audible warning is sounded and a light is flashed. In the experimental unit, the system can be switched to the automatic braking mode and the brakes applied automatically for dangerous driving situations. The range, closing rate, and ground speed are displayed on three panel meters mounted on the dashboard. However, it is not expected that these measured quantities would be displayed in an operational system.

The harmonic radar system is unique in its ability to eliminate false targets and

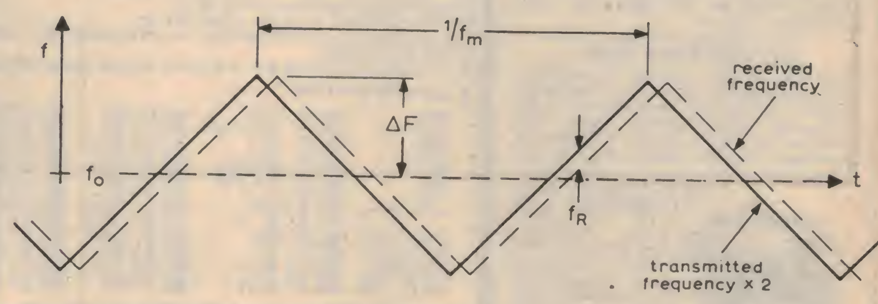


Fig. 7. Modulation scheme of harmonic radar.

clutter, in its immunity to blinding by radars of similarly equipped vehicles, and in its potential for providing automatic braking for specifically tagged off-highway collision hazards or wrong entrances to one-way streets and highway access ramps. When in general highway use, it also has the potential for providing higher traffic packing densities without running the risks of massive "pile-ups."

The radar uses solid-state components throughout, and is adaptable to integration and printed circuit techniques. It uses a frequency spectrum that is still not crowded and, with a power density over the antenna aperture of 0.15mW per square centimetre, it does not constitute a radiation hazard, even in the immediate vicinity of the radar.

Although it is a co-operative system in that all vehicles must carry the harmonic reflector, the reflector is completely passive and could easily be fitted to existing vehicles. In addition, the reflector would be quite inexpensive under mass production conditions. The co-operation required would be no more burdensome than the requirement to fit red tail-light assemblies; and the purpose is the same — to aid in preventing collisions.

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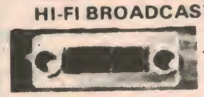

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Forum

Conducted by Neville Williams

Organ loudspeakers pose quite a problem...

How to obtain smooth, sustained, fundamental bass from an electronic organ is a problem which faces many enthusiasts. Unfortunately, it's likely still to be facing them when they've grown too frail and weary to care! It's that kind of a problem — one to which there's no easy, universal solution.

Fighting words? Maybe they are.

One can rarely express a conviction about electronic organs without buying some kind of an argument. Organ enthusiasts are a dedicated lot, even fanatical, and intent on defending their particular point of view and their particular choice of instrument.

Privately, I may tend to do the same but, just here, I am more interested in opening up a particular facet of the subject. It may merely revitalise old arguments but, again, it may bring to light opinions and experiences which will be of mutual benefit.

What started me on this track was a letter from a correspondent from Yarralumla, ACT which reads thus:

Dear Sir,

You may feel this topic of enough general interest to write a "Forum" on it, or you may feel it is an imposition on my part and file it appropriately.

My problem is one common to anyone looking at the reproduction of organ music electronically: how to achieve an even volume of bass notes down to the 32.7Hz needed for the 16' pedal C.

Speaker specifications tend glowingly to assure one that the particular unit will reproduce tones from 25Hz to 1100Hz with a fundamental resonance of 40Hz etc. However, the response curves produced for this same speaker show a point (50Hz) from which the sound level slopes off 10dB until the low point of 30Hz.

It would seem likely that such a reduction (roughly ¼) in volume would be very apparent as one pedalled down from G to C. Is this in fact, aurally apparent, and what are the recommended techniques to overcome the problem?

I am interested in modifying my organ to give it five channels, and use a Playmaster 140 amplifier which will otherwise serve my HiFi. Hence the situation is further affected by the need for reasonable efficiency in whatever speakers I do acquire, in order to allow satisfactory volume levels.

My situation is probably unusual, however, in that I have a cupboard over a stairwell which is approx 5ft 6in long, 3ft between studs, and triangular from 8ft high to approx 4ft 0in (from ceiling) in which I can set up the speakers, as its triangular wall and a 3ft x 8ft end wall is common to living room. Hence baffle or box sizes are not as critical as is more generally the case.

With the above in mind, are horns a better proposition than vented enclosures, or would it be perfectly satisfactory to build the speakers into the wall, sealing their backs from one another? The main question really is how do you overcome the tail-off effect as one goes down through those last few notes?

I hope you find this interesting enough to warrant your attention.

I.H. (Yarralumla).

Well, the fact that the letter has been included as the basis for this month's Forum is indication enough that we do consider the subject of fairly wide interest, and to discuss it is therefore not an imposition.

Let's do as we often do: start at the beginning.

Most electronic organs have at least one octave of bass pedals at 16ft pitch, which will deliver output frequencies in the range 32 to 64Hz. But, it is one thing to have the signal frequencies available; it is quite another to propagate them as sound, and to produce the deep, tummy-rumbling effect which characterises 16ft foundational bass.

In point of fact, it is problem enough to obtain an octave of bass which sounds uniformly loud, without worrying about its purity and quality!

The problem facing an organist is different from that facing, say, a guitarist. Guitar players quite commonly settle for loudspeaker systems which have resonance effects within the playing range but they can compensate, perhaps almost unconsciously, by the way they play individual notes.

Added to that, with a lot of guitar music, a beaut resonance provides the basis of a beaut beat!

The organist has no such "out". His bass pedals are simply off-on switches, not in the least touch conscious. If one bass note sounds much louder than the next, he is stuck with the effect — and the liability. Nor can he compensate much with his expression pedal, because that affects the volume of all other notes being played simultaneously.

Hence my earlier remark that the loudspeaker system associated with an organ should produce uniform subjective loudness over the pedal range as a minimum requirement. If that "loudness" can be attributed to the fundamental pitch rather than an exaggerated harmonic content, so much the better.

It might seem that, if one is to produce smooth, fundamental bass from 32Hz upwards, a logical starting point would be a loudspeaker with a very low system resonance — say 30Hz.

Unfortunately, one immediately comes up against the unkind realities of loudspeaker design. A loudspeaker with such a low resonance needs either to be: (1) very large, or (2) have an unusually long cone and voice coil travel, and soft suspension. If the latter, it is likely to be anything but rugged and it will also be very insensitive unless fitted with an oversize magnet structure. In turn, this will make it expensive and heavy — altogether a not very attractive package, commercially.

But that is only half the story. A loudspeaker will not propagate 30Hz energy into the listening area unless it is adequately baffled to inhibit or control interaction between the front and rear radiation. And that's a tough requirement to meet.

Most organs, as self-contained instruments, have loudspeakers mounted in the front face of the console, where there is a seemingly useful and convenient baffle area. But appearances are deceptive.

Organ consoles have to support the mechanics, house the electronics, accommodate the player and to look attractive! Only in very rare instances is there any opportunity to build a proper acoustic enclosure behind the loudspeaker without conflicting with, or compromising access to the rest of the instrument. Usually, the pressure wave from the back of the cone can sneak round to the front past the expression pedal, up through the keyboards and via the not-very-substantial console back.

Proper radiation of 30Hz energy in these circumstances is highly unlikely.

The fact that console loudspeakers have to operate in virtually "open back" conditions, and withstand heavy usage, provides an additional reason to select fairly conventional 12-inch heavy duty types with fairly stiff cone suspension. But that certainly doesn't mean any "conventional" type.

The problem is that the main system resonance for many such loudspeakers falls within the range 32 to 64Hz. This can only be tolerated if the acoustic output at resonance does not rise to an obvious peak. Loudspeakers most likely to satisfy this requirement are found amongst the more generously designed types, with a heavily textured cone and a high magnetic flux — driven by an amplifier with very low output impedance.

Depending on the price level of the organ, there may be one such loudspeaker, or two of them; in the latter case, the designer has the opportunity of selecting units with a deliberately different system resonance.

With care, it is possible to achieve a reasonable subjectively level bass output from the console — but it won't be all 16ft sound. Much of the loudness of the lower notes will come from harmonics, as commonly generated by loudspeaker(s)

FORUM

operating below their system resonance. As higher pedals are played and the frequency rises, the 16ft fundamental will become more prominent, the spurious harmonics will diminish and (hopefully) the subjective loudness will not alter much.

There are some interesting facets to this. The small organ once marketed in this country by Stromberg-Carlson (originally a Thomas design) used a single not-very-expensive loudspeaker with a resonance deliberately located in the gap between the lowest note on the manual and the highest note on the pedals. This was possible because the rather short manual had no 16ft voice and the pedals had no 8ft. Had it been otherwise, some notes would have been riding over the resonance with, possibly, undesirable results.

Another variation in approach is represented by Yamaha, with their very large heart-shaped "natural sound" loudspeakers, which occupied most of the frontal area of some models. Such a large cone could not possibly be baffled in the usual way but, with its very large frontal area, it could hardly avoid moving a lot of air at low frequencies. It would be a brave engineer, nowever, who would claim that Yamaha had found the compleat answer.

In the face of all these reservations, it is not surprising that enthusiasts are agreeably impressed when they hear the bass from their pet organ propagated through an adequate external loudspeaker system.

But what constitutes an "adequate" external system? That is the question raised by our correspondent. Isn't it true that most so-called high fidelity loudspeakers show a marked falling off in output below about 50Hz? Doesn't this disqualify them from consideration? But if it does, how can they be satisfactory for high fidelity reproduction — including reproduction of organ recordings?

In answering such questions, I think that one should begin by ruling out all systems which merely pretend to high fidelity; nondescript loudspeakers in nondescript boxes of the type which come with cut-to-the-bone stereo systems. We should also rule out sub-compact systems, even the carefully engineered ones.

Leaving these groupings aside, my own experience suggests that the bass from an electronic organ generally acquires a fuller, richer sound, even when fed through compact, properly designed enclosures — despite their tapering bass response.

The reason, I think, is that such enclosures are designed so as to minimise peaks and troughs in the bass response, and to produce an output that is reasonably smooth and clean sounding, even if it does taper below 50Hz. Thus, while response from the pedals may fall off towards the low C, there will be no sharp differences between adjacent semitones and no obviously ragged notes.

This is another way of saying that, within their power limits, good quality compact enclosures may show fewer aberrations in the bass range than the loudspeakers commonly housed in a console.

There's one reservation: reflex enclosures are rather less predictable in this respect than the damped, sealed type. Their overall efficiency at the bass end is normally higher but it can be more lumpy, leading to unevenness between semitones. Such a characteristic is particularly noticeable in an organ situation, where the player can play bass notes one at a time and listen for differences!

Not all reflex enclosures are like this, but some are.

However, while compact high fidelity enclosures can produce reasonably good organ bass, one usually finds that bass performance will improve with increasing system dimensions — just as does the bass end with recorded music.

In short, the limitations of console mounted loudspeakers are usually such that external hifi loudspeakers — particularly the larger ones — will usually outperform them, despite reservations one might have after examining response curves.

But, there are two important "buts" . . .

Whether propagated through console or external loudspeakers, the low frequencies are still subject to the acoustic limitations of the listening room. Unfortunately, the average living room, with parallel surfaces and limited dimensions, is characterised by strong standing wave patterns and an inability to support 30Hz energy.

So, while it is undoubtedly better to start out with a good loudspeaker system, rather than an indifferent one, the average room will remain a liability. Typically, some semitones which may seem very weak at the organ stool, may be overpowering at other points in the room; and vice versa.

Again, an organ using only console loudspeakers in a large room, may sound better than a similar instrument with expensive external loudspeakers in a small room. This sort of thing can be particularly frustrating to the avid organist who doesn't happen to have a large room to spare!

There's that other "but", this time to do with the rest of the frequency range.

One of the characteristics which designers of a hifi loudspeaker system aim for is a flat response extending, hopefully, to the limits of audibility. Feed an electronic organ through such a system and, along with the improved bass, you may well hear an over-generous helping of overtones, making the organ sound unpleasantly "reedy". The reason is not hard to fathom:

Most organs derive their basic tones from square and/or staircase waveforms, which are filtered back to retain a residue of harmonics appropriate to the required sound. This is as heard on the organ's own loudspeakers so that, in a very real sense, the organ speakers are part of the voicing. If, as usual, they taper off in the treble register, substitution of a wide-range system is tantamount to reducing the value of all the capacitors in the harmonic filters!

So, if you do decide to feed the organ through hifi loudspeakers, be prepared to put up with a more reedy sound, or else arrange some electrical top cut.

Similarly, if you decide to connect the organ to a complete hifi system, and to cope with the connections and the switching, remember to turn down the treble control to a selected position before you start to play.

I've used up both the "buts" mentioned earlier but here's another one for good measure.

Hifi loudspeakers are usually placed in a room so that they can create a firm stereo image. Used with an organ, they will localise the sound just as successfully. But an organ generally sounds best when the sound is diffused.

I know that there's a practical limit to the number of loudspeakers and things one can accommodate in a room.

I know that it seems superficially logical to couple hifi components to an organ when the two are side by side.

But my own conviction is that the two are not really compatible. If at all possible, provide the organ with its own external loudspeaker system, and tailor that system to the needs of the organ.

Our correspondent would seemingly be well placed to do just this. He has a generous space in which he can instal one or more big loudspeakers with good bass, good middle and not too prominent a treble response. Make the partitions substantial, pad the inside surfaces generously and he should be able to make the listening area really throb.

Provide a 5-channel system, involving the Playmaster 140?

Frankly I wouldn't.

As a quadraphonic amplifier, the 140 can feed about 60W RMS watts into the listening room — provided all channels are contributing to the sound as they normally are, especially at the bass end. But break them up into four separate channels used, perhaps, one at a time and the power limit per solo channel is 15 watts or thereabouts.

This, in addition to the problems mentioned earlier: too much treble response and too obvious a directivity.

By all means, I.H., install the 140 but optimise it as a quadraphonic system for record and tape reproduction. But consider the organ as a separate installation and optimise that as well.

You don't agree — all you organ enthusiasts?

Well, it's over to you!

Dick Smith Ele

TAX-FREE CALCULATORS

With so many calculators on the market, how do you know which is best? Easy, ask Dick. He's checked 'em all and chosen five that are top value. So there's no need to spend hours comparing: we've done it all for you!
And to add to the value, we can supply TAX-FREE to approved purchasers. Does anyone else offer such service? Even if you can't complete the Tax declaration, you won't beat our prices because we've bought large quantities. So check which one you fancy. NOW.

★ **Satisfaction Guaranteed**
Try any of these calculators at our expense. Simply send your remittance and if not satisfied return the calculator within 7 days. We will refund your money less cost of P & P.

How To Claim Tax Exemption
Simply get the whole of this declaration typed out and completed, attach to the coupon and forward with your remittance. Or if applicable quote your tax number. We will despatch INSURED by post for $2.00.
Fill in the relevant words or signature where brackets are used below.

I hereby certify that the (Make, Model) calculator purchased by me from Dick Smith Wholesale Pty Ltd on (date) is for use in (school, university or organisation etc.) in or directly and essentially in connection with the production of facts by means of observing, measuring, testing or otherwise experimenting with material phenomena or the purpose of proving or illustrating natural principles and laws or in the study of pure and mixed mathematics. Exemption is accordingly claimed under Item 63,1 in the 1st section of the Sales Tax exemption and classification act. Signature of officer of school, university or organisation: (sign and name in capitals). Designation: (job title) Name of school, university or organisation (name) Signature of student: (your signature) Name and address of student: (yours in capitals) Date: (date).

PLEASE USE COUPON TO SPEED DELIVERY

Please send me a .... calculator.
Tick box if you are enclosing a typed copy of the Tax Declaration, fully completed or Tax Exemption Form/Number on official order ☐
I understand $2.00 P & P includes insurance.
I enclose my remittance of $..................
NAME..................
ADDRESS ....
....
.... Postcode ....

SHARP ELSIMATE

Our special Tax-Free Price

$27.25

$28.75 inc. Tax

Ingenious 12 digit capacity displayed in blocks of 3 digits. 9 to left and 3 to right of decimal. Pos, negative indication; decimal, thousands and millions plus overflow; mixed calculations. Handy counter facility with pushbutton to add 1 to display number.

HANIMEX BC81

Our special Tax-Free Price

$27.25

$29.25 inc. Tax

Compact and easy to use the BC81 performs addition, subtraction, multiplication and division, has decimal selection to 2 places, zero suppression, true credit balance, automatic "fade-out" (display fades out after 30/45 secs. if no further entry is made) and recall of last entry after "fade-out". The BC81 also has indicators for decimal selection, overflow input, overflow result, negative entry or result and battery renewal. Complete with batteries and case.

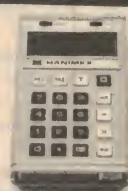
HANIMEX BCM817

Our special Tax-Free Price

$45.45

$49.95 inc. Tax

Cheapest with Memory



Hanimex have packed a lot into the 5½ oz. BCM817. Besides a memory to store any interim answer for later calculations, it has a constant facility, result and memory overflow/underflow indications, leading zero suppression and a floating decimal point, 8 digit display, 16 digit capacity. Complete with batteries and case.

★ **MAINS UNIT TO SUIT HANIMEX CALCULATORS ONLY $15.00**

HANIMEX BCM850

Our special Tax-Free Price

$54.00

$59.00 inc. Tax

Mini Desk Model

The BCM850 is a battery-operated, mini-desk-size electronic calculator with keyboard large enough for day-in, day-out operation, yet it's small enough to fit into a briefcase. Includes such important features as MEMORY to retain intermediate answers, 8-digit display, floating decimal, % key, constant and indicators for memory, negative and overflow. It also provides automatic display fade (with instant recall) to conserve power. Complete with batteries and case.

SHARP PC1801

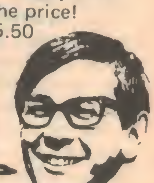
Our special Tax-Free Price

$152.00

$169.00 inc. Tax

12 Scientific Functions — This is a really professional calculator with 12 scientific functions built in Trig, inverse trig, hyperbolic, exponentials etc. Naturally it has a memory, constants, chains and power calculations. Square roots, reciprocals, logs, etc. Degrees/radians selector. 8 digits, full floating decimal. Indicator for pos/neg, memory and battery low. Compare it with that one at twice the price! NiCad battery pack to suit only $35.50 including charger.

I worked these prices out on one, so they'd better be right!



DICK SMITH WHOLESALE PTY LTD

Head Office and Mail Orders to 160-162 Pacific Highway, Gore Hill NSW 2065 Telephone 439 5311
Also at 361 Hume Highway, Bankstown (100yds from Chapel Road)
Tel 709 6600 P&P 50c unless otherwise stated.

ctronics Centre

Dick answers your questions

We have been absolutely inundated with letters and comments following our recent Newsletter. As our 15,000 regular customers will know we asked you whether it was worth keeping up our backorder system. I can answer you now:

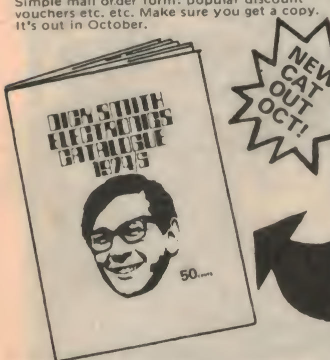
YES WE WILL CONTINUE TO RUN A BACKORDER SERVICE for our customers convenience, even though many suppliers have stopped their's. We have simplified the system as you will see on your next order form.

Unfortunately the matter had to be distributed in smallish quantities at a time because of the postal dispute and the offers of free transistors etc. were possibly all taken up before some of you got your orders in. Our apologies, but we will ensure that the next newsletter gets to you first!

To readers who may not have tried our Mail Order system, I'd like to tell you that every one of our regular customers is on a special mailing list and that the items that go in our newsletter are not advertised in the magazines unless they are not cleared. But when you're giving away free transistors or real bargains we are usually embarrassed by the response. The moral then is to place even the smallest order so that your name gets onto our lists.

New Edition of the Famous Catalogue out next month

Watch the magazines for further details of how you can get the most useful catalogue around . . . full of specs and data everyone needs. 64 pages crammed with small print (it's the only way we can get everything in!) Simple mail order form: popular discount vouchers etc. etc. Make sure you get a copy. It's out in October.



Three new books in the Question and Answer Series

Here's the easy way to know a subject without getting lost in the maths. Simply ask questions and from the answers think of more questions. So here's how they go:

Q&A on Colour T.V. Four sections — colour signals and transmission, displays, decoding, convergence. First question is 'What is light?' leads right through to 'How is the blue lateral convergence current obtained?' 108 pages, hard-back **$2.65.**

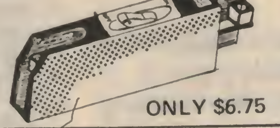
Q&A on Radio and TV (new edition) has 7 sections and starts with 'What is an electric current?' leading on to 'How are line and frame pulses separated?' and 'What is a Foster-Seeley discriminator?' 130 pages, hard-back **$2.65.**

Q&A on Electronics has 9 sections going from 'What is meant by electronics?' on to 'What is meant by bandwidth?' and 'Can alternators be synchronised by Electronics?' 112 pages, hard-back **$2.65.**

Transistor Pocket Book by Hibberd of Texas Instruments, 300 pages **$4.75.** In 18 chapters there's a good grounding in characteristics, dc conditions, amplifiers both high power and high frequency, oscillators, radios, switching, dc amps, power supplies etc. Plenty of circuits and diagrams to help you along and little difficult maths. Useful chapters too on handling and testing.

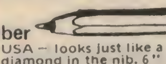
Tired of fixing fuses?

Even your wife (sorry girls) can fix these Heinemann Contact Breakers. We've got them in for you experimenters who get through fuse wire faster than you can use the solder. Full 10 Amp rating. Made in Australia and patented. Looks like a switch and automatically goes off when rating exceeded. Easily installed on your work bench to give ample protection. Massive construction and with full insulating case. You won't believe how cheap they are — **$6.75.**



ONLY $6.75

Diamond Scriber



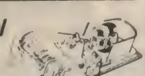
Fresh in from the USA — looks just like a ball point but has diamond in the nib. 6" long plastic handle. Ideal for marking PCBs and metalwork. Excellent too for cutting glass and tiles etc. Small size is ideal for confined spaces. Manufacturer claims they are used to cut IC chips! **$2.75** (P & P 30c)

New computerised resistor packs

You know the usual resistor packs with 2 or 3 resistors of every value including 33ohms, 18k and 39k that you hardly ever use? Well ours is different. It's based on a Philips computer listing which shows the values that are used the most. So our pack contains 20x1k and only 2x56ohms. However there are at least 2 of every value from 22ohms to 470k. A total of 50 different values and over 260, ½W, 5% carbon film resistors. Normal Value over $8.00. Ideal for service people and hobbyists and only $6.50 (P&P 50c)

ONLY $6.50

Simple Electrical Kit Packs



These are very easy to build real working models. See how the basic principles work in practice. Four to choose from with full instructions and they are extra easy to build. No soldering needed and will give a lot of fun. Electromagnets pack 80c. Bell $1.00. Motor $1.50 (All P&P 50c)

Plessey Antistatic Record Cleaner

in 12 oz. spray pack complete with FREE cleaning cloth. Look after your records by preventing dust-attracting static. Keeps them clean and as new. Surely your records are worth more than **$1.50.** Get a can now!!

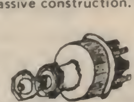
Just check some of the contents:

- Enormous 64 pages packed with illustrations, specs etc.
- Special information section full of essential reference data. (It's worth getting the catalogue just for that alone!)
- Usual discount vouchers and simple mail order form.
- Enlarged technical book section
- More Amateur Radio Gear — whole page on antennas etc.

If you're a hobbyist, Amateur, serviceman, technician . . . in fact if you're anyone at all you'll need a copy.

Burglar Alarm/safety switch.

We found them hiding in a corner. Similar to a vehicle ignition switch. Key operated for security. Position 1 off. Position 2 Auxiliary on. Position 3 'Ignition', Position 4 'starter'. Position 4 is spring loaded as in most cars. Key can only be removed in off position. Heavy duty contacts. Approx. 2" diameter. With 2 keys, made in USA, massive construction. ONLY **$2.00** each.

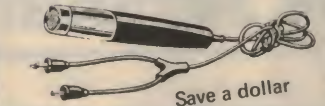


$2.00

Headphones

SA32D phones are ideal for stereo systems and low power amplifiers. Soft padded ear cushions and fully adjustable headband. 8 ohm impedance and response from 25 to 18,000 Hz. Complete with 200 mm cord and plug and value at only **$5.95** (P & P 75c)

AH38LS is the professional job with volume AND tone sliders to individually adjust the output to each ear for perfect sound. Ultralight weight for hours of enjoyment. Response from 20 to 20,000 Hz through 3" dynamic speaker. Complete with 3 m of coiled cable and plug. Recommend at **$14.95.**



Dynamic Mic bargain

This is a remote control type with an impedance around 500 ohms. Ideal for cassette recorders fitted with switching socket. Response from 900 to 10,000 Hz. Black finish with silver insert 12 ½ cm long X 2 ½ cm dia. fitted with P2 and P1 plugs. Normal price is **$3.90.** We have 150 at only **$2.90** (P & P 75c).

Zippy Boxes

At last we've been able to find some decent boxes for project builders. These are in ABs, so they're easy to drill. Posh grey finish with posts in each corner to take self tapping screws and ingeniously arranged to hold a PCB. Supplied with ally panel which fits all ways round (such is the precision of these boxes). Dimples for feet or stick your own on. Special insulated panel available and matrix board panel making these boxes ideal for experimenters boards. We are importing them by the 1000 knowing that you've been waiting for something like this to dress up even the most ordinary project.

Two sizes UB1 **$1.80** 15 x 9 x 5 cm
UB3 **$1.50** 12 ½ x 6 x 4 cm

Matrix board to suit 60c, black bakelite panel 50c (state which size).

Kits

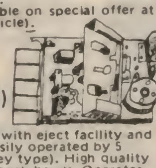
FERRANTI ZN414 MICRORADIO IC KIT

$6.75

(as featured in Electronics Australia May '74). At last you can build a true miniature radio. IC features a 10 transistor circuit which requires only tuned circuit and 3 parts. 72dB gain. Operates on 1.5V and only 300μA. We've seen one in half a matchbox, can you beat it? No case supplied because you'll want to build it your way.

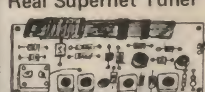
Minikit still available on special offer at only **$6.75** (see article).

Vortex Cassette Deck (see August E.A.)



Complete mechanism with eject facility and resettable counter. Easily operated by 5 pushbuttons (piano key type). High quality erase and record/playback heads. Operates at 4.75 cm/sec. ±1.5%. Wow and flutter claimed better than 0.25%. Model CTS100PC only **$29.00** (P & P $1.00).

Real Superhet Tuner



only $7.90

Yes all the parts for a 3 transistor superhet tuner. Printed circuit, all coils, ferrite bar antenna, tuning gang etc. Covers 530 to 1600kHz (dial included). Measures only 45 mm X 135 mm. Ideal for converter IF strip (cheaper than parts alone). Self oscillating mixer, 2 stage IF amp with AGC, and diode detector. NPN transistors operates off 9V. Why fork out $20. Our's is only **$7.90** (P & P 75c).

Transistor Tester.

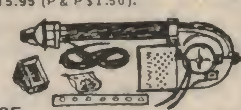
Although this one is very simple and straightforward it is very popular because it checks Bipolars, FETs, diodes, SCRs, PUTs and other semiconductors. Can be used for both good/bad checking or more serious measurement of parameters. Posh panel and large clear movement. Very popular at **$15.50.**

DSE-260 Signal Injectors

During our recent stock-take we found 100 of these packed away. So here's your chance to get a deluxe Injector at last years price. An injector is the first, basic signal generator that every hobbyist needs (a lot of professionals use them too). Run through a radio, t.v. or amplifier and isolate faults in seconds. The 260 is extra powerful and pumps out a full 2Vp-p, so you don't need to make intimate contact with the probe (a good time saver). Usable up to 150 MHz on harmonics and with patience. No knobs to twiddle or critical frequencies. Just dab the probe in starting at the output and working towards the input until the signals die and hey presto there's your fault! Posh fluted and plated, easy grip case. Switched off until you use it, so no flat batteries. Simple push switch action. Batteries included (2 X 1.5V) and complete with instructions. Hurry, still at only **$8.50.**

Electric Car Antenna at a price you can't afford to miss!

We have the beaut Harman automatic aerial which goes up and down at the flick of a switch—5 chrome sections giving a full metre extension. 12V operation, supplied complete with leads, brackets, full instructions and handsome switch. Sling your aerial away and fit this yourself in half an hour. Measures 30 cm X 10 cm X 6 cm approx. Normal retail price is $21.00. Get yours for only **$15.95** (P & P $1.50).



$15.95

Vedubbers delight

At last we have located a 6V radio for VW owners. It's the SR206 and it's really special because when you get a 12V VW (or any other car) you simply flick a switch for 12V operation. Install it yourself. Supplied complete with big 7 X 5 speaker, aerial, suppressor etc. Normal price $83.00. We have them at **$69.95** (P & P $1.00). Can be used with pos. or neg. earth on any 6 or 12V vehicle.

Multimeter Scoop.

Did you hesitate over our $10.50 offer — too bad. We knew that there would be terrific demand so we have made arrangements for some more meters. Check these and don't delay:

Model 3-030 has 5 dc ranges from 5 to 1000V, 4 ac ranges from 10 to 1000V, 2 dc current ranges, 2 resistance. Off position and decibel scale. 50 uA protected movement. Mirror scale. Complete with battery and test leads. Full 20,000 ohms per volt. Yours for just **$12.50**, full instructions and circuit supplied (P & P $1.00).

$12.50

Model 62D has 6 dc voltage ranges, 5 ac voltage ranges, 3 dc current, 2 resistance and 2 CAPACITANCE. Large mirror scale 50 uA movement. Off position. Full instructions, battery, test leads etc. The only meter at this price that can do checks on capacitors from 10pF to 0.1uF. But hurry, only **$13.50** (P & P $1.00). Protected movement.

$13.50

The Serviceman

A glimpse of things to come

How do you feel about the introduction of colour TV? Are you confident you will take it in your stride or are you thinking, as a colleague jokingly puts it, of giving the game away and buying a chicken farm? Either way, the following report on an Australian made colour TV set should interest you.

Along with a group of other dealers and servicemen I was recently a guest of the Philips organisation, to view one of the colour TV sets which they intend to market. Since this was my first close look at an example of Australian colour TV sets, I found it particularly interesting and informative. I feel that readers will be equally interested.

But first a word of warning. Since this is the first set I have had a chance to see, I have no way of comparing it with other makes, even assuming I wished to do so. Therefore these comments are in no way intended to imply criticism of any other make. They are simply my record of the set and its history as presented by the company, and my impression of it as I saw it.

Two models of the set are to be released on the Australian market; one with a 22in tube and one with a 26in tube. Both tubes are proven conventional triad type shadow mask tubes, with 110 degree deflection and large diameter neck. The circuits are fully solid state and the EHT is derived from a voltage tripler circuit which significantly reduces X-ray radiation compared with the older thermionic circuits.

Both sets are based on the Philips "K9" receiver design, which was originated in Europe as a universal design which would be suitable (with appropriate minor changes) for all the PAL television areas in the world. To date some three million of these sets are operating throughout the world and the information gleaned from their behaviour in the field should be of considerable benefit to Australian engineers, particularly in building in a high order of reliability.

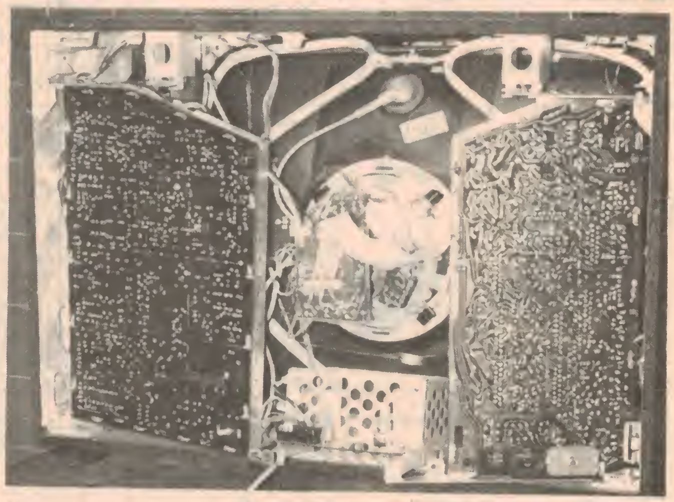
There have been three main changes to the design to make it suitable for the Australian market. (1) it has been fitted with a power transformer due, at least in part, to the fact that the supply authorities have not taken kindly to suggestions of a "transformerless" design. (2) the IFs have been changed to conform to the ABC Board requirements, and (3) a turret tuner has been substituted for the push button tuner used in the European model. This is due mainly to the need to accommodate Australia's 13 channels, plus an extra channel for possible extension into the UHF bands via a converter, and simple modification.

The power supply is a novel arrangement, compared with conventional monochrome TV sets, but is one which I understand will, in broad principle, be employed by most of the local manufacturers. Briefly, the mains supply is first converted to 18kHz then fed to a small and very efficient transformer.

This type of power supply lends itself to very effective voltage regulation, a valuable feature in any TV set, but particularly so in a colour type. In this case the makers claim that, when designed for a nominal 240V supply the set will automatically cope with any variation between 160 and 360 volts. Also, it will cope equally well with slow changes or rapid ones.

This ability was very effectively demonstrated. A set displaying a colour test pattern was fed from the mains via a variable voltage transformer, which enabled the voltage to be varied between 160 and 280. A table lamp connected to the same supply provided ample evidence that the voltage was, in fact varying. This was just as well, because the test pattern did not vary in any detectable degree in regard to picture size, geometry, brightness, colour hue or colour saturation.

The overall performance of the set was demonstrated with both test patterns and program material from tape. Although the latter was only ½in tape on a relatively simple video recorder, the result was most impressive.

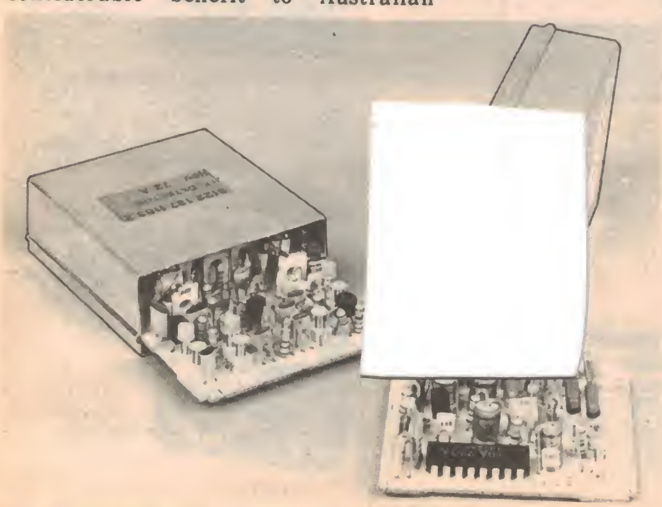


The Philips set with the rear cover removed. The "large signal" board is on the left and the "small signal" board on the right. The power supply is in the centre, beneath the picture tube.

Not only was it a good advertisement for the set, but for colour TV as a whole. I never watch a colour TV demonstration without being forced to realise just how much colour has to offer in terms of added entertainment value. One segment of tape was a swimming event from the recent Commonwealth Games in New Zealand and the impact of colour on such subjects cannot be described; it has to be experienced to be appreciated.

I am confident that those diehards who claim that they can see no advantage in colour will break down in the first six months.

But to get back to the set itself. As a serviceman, my main interest was in the servicing problems likely to be introduced by colour TV in general, and individual sets in particular. I — and I sense a lot of others at the gathering — were asking themselves how this set was going to measure up in this respect.



Three of the modules used on the "small signal" board. Each board measures 52mm by 53mm, is housed in its own shield can, and plugs directly into the main circuit board. Each module is designed to be cheap enough to discard if it develops a fault.

The company's expressed attitude in regard to servicing is two fold: (1) to design and build the set to have the highest possible reliability, such that servicing will be reduced to a minimum, and (2) that when servicing is necessary it should be made as simple as possible, with the emphasis on minimum labour cost.

In regard to the first point, the makers claim that they have achieved a very high order of reliability. Quite naturally, this feature is aimed primarily at the customer; if the customer can be convinced that this particular set will involve him in a minimum of service calls he is likely to buy it in preference to one about which he knows little or has reason to suspect. And this in spite of any price difference. Similarly, a dealer is more likely to recommend a set about which he is confident.

The set's reliability is based, in a large measure, on deliberate overdesign and the use of components with conservative ratings. The company maintains that in our current financial climate, where labour costs are high and still rising, it is better to spend a little more on the cost of components in the first place, than a lot more on the cost of repairs later on — to say nothing of the goodwill angle.

The company quoted the following reliability figures to emphasise their point. According to them the average number of service calls (excluding nuisance calls) for monochrome sets on the Australian market is currently two for each 1500 hours use. (Approximately one year.)

For the K9 set they claim a figure of better than one in 1500 hours (about 0.9 in fact). On this basis they claim that their colour set will be twice as reliable as the average monochrome set now in use in Australia.

These figures would seem to contradict the oft quoted rule of thumb which claims that, because a colour set has approximately three times as many parts as a monochrome set, it will require three times as many service calls.

While such elementary reasoning may be suspect anyway, it must also be remembered that the "'average" monochrome set includes some sets between 10 and 15 years old; sets which, in addition to using valves, use paper capacitors and, in some cases, resistors of relatively primitive design.

By comparison, any modern set, colour or monochrome, by any manufacturer, can take advantage of solid state techniques, a range of capacitors which are inherently many times more reliable than the old paper types, and resistors which have been similarly upgraded. Assuming that the manufacturer took full advantage of these improvements, and avoided skimping, it would be surprising if such a set was not significantly more reliable.

Nevertheless, it is gratifying to learn that at least one company has recognised this and set itself a goal which not only offsets the greater complexity of the colour set but, hopefully, betters the reliability in spite of it.

But what of the servicing situation when a fault does occur? Here, I feel, the designers have done a particularly good job. It is obvious that a lot of thought has gone into making the set easy to service; a pleasant change from some of the mechanical monstrosities which have been foisted on us in the past.

There is no chassis in the conventional sense. The main circuitry is constructed on two printed wiring boards, both fairly large, but one about twice as large as the other. The larger board is known as the "large signal" board, and carries the deflection circuits, EHT circuits etc. The smaller board is called the "small signal" board and carries the IF system, video system, sound system etc.

These two boards are mounted vertically on the left and right rear edges of the cabinet, the large one on the left, the small one on the right. They are held with simple pivots top and bottom and connected to other parts of the set via suitably restrained cables. Thus they may be swung out to provide easy access to either side of the board, while the set is running.

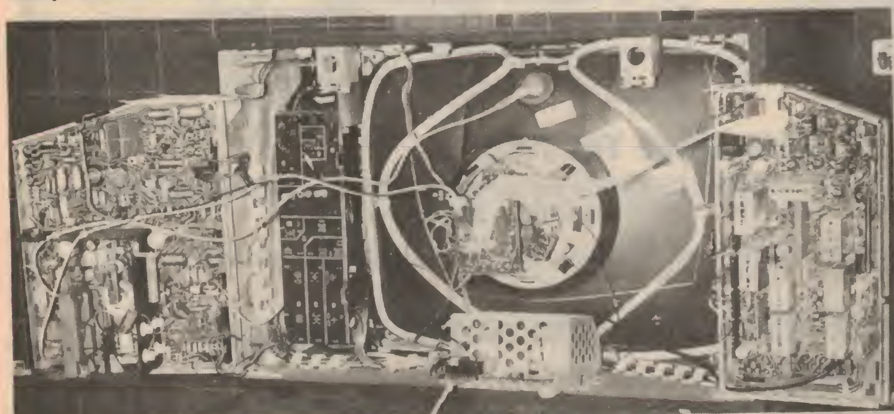
The cabinet back is of moulded plastic, held with four simple clips. It is claimed that this back can be removed and the two boards swung out in the servicing position in 20 seconds.

A copy of the printed wiring pattern is reproduced on the component side of each board, while all components carry a code number. These two features alone will significantly reduce service time and familiarisation with the layout.

The two boards are printed in distinctive colours, and these two colours are repeated in the circuit diagram, still further reducing search time.

The boards themselves may be readily removed and replaced, all connections to

All sections of the industry — and the buying public — are worried as to how well the service industry will cope with colour TV. As far as the makers of National colour TV sets are concerned, they are determined that their customers will be fully protected in this regard. Their policy is to accept as retail outlets, only those organisations which employ fully qualified colour TV technicians. National regards as fully qualified only those technicians who have successfully undertaken full colour TV training courses at government run technical colleges, or private institutions with comparable instruction and examination standards. Then the company's training program takes over. This will be a series of linked half-day and one-day technical seminars throughout Australia for the service staffs of National dealers. These will cover such aspects of colour TV as circuit explanation, set-up adjustment procedures, recommended service techniques, etc. including National's exclusive five-board, modular construction with its provision for speedy maintenance. The first half-day is an introductory session for the second, which covers the full technical details of the company's colour TV sets. These seminars are restricted to fully qualified colour TV servicemen and are not in any way a substitute for the lengthy course required to convert a monochrome technician into a colour technician. The picture shows Mr Allan Yee, National's Australian Service Manager, instructing colour TV technicians on the unique features of a National colour TV set.



Rear view of the Philips set with panels swung open for servicing. Eight plug-in modules can be seen on the board on the right. The convergence controls are to the left of the picture tube, but hinge out the front of the cabinet when needed.

them being via plugs and sockets. And, while this approach is not recommended as the normal one, it is suggested as the best way to attack a stubborn intermittent; replace the board with a spare to give the customer immediate and positive service, then return the board to the workshop for more detailed examination when time permits.

To cope with the more routine type of fault, extensive use has been made of plug-in modules. These consist of a printed board, about 2in square, which plugs into an edge connector. The ones I examined contained upwards of a dozen components. They are housed in a small metal shield.

Most importantly, they are designed to be cheap enough to throw away. Again, this idea is based on the philosophy that components, which can be turned out in vast quantities by mass production, are cheaper than labour. It is therefore often cheaper to replace a whole batch of low cost components than to employ a highly paid skilled technician to determine which particular one is faulty.

And, to give some idea of the thought which has gone into the design, the pin connections to these modules have been so arranged that, in the event of module being plugged into a wrong socket, no damage will result to either the set or the module.

The service manual contains the main circuit plus numerous instructions and diagrams, more or less in the conventional manner. But it also contains an extensive trouble shooting chart, on which is listed the normal symptoms encountered in the field.

For each symptom a series of checks and tests are listed, starting with such simple and (apparently) obvious things as the setting of appropriate controls, condition of aerial and feeder etc, and progressing to replacement of nominated modules, voltage checks etc.

As a further aid to simplified servicing, the convergence controls are accessible from the front of the cabinet. I have not, as yet, tackled the convergence of a set in the field, but it does not take much imagination to visualise the frustrations one could encounter when trying to work from the rear of the set via a mirror. For one thing it is difficult to provide a large enough mirror to present the whole of the screen at one time, unless the mirror is so far away that the fine detail of the adjustment is lost.

In this set there is a front panel beside the picture tube which carries the tuner, the various user controls, and the speaker. This is easily released to fold down, and brings with it a panel carrying all the electrical convergence controls. These are numbered and colour coded so that each adjustment may be made in the right order, according to printed instructions.

EMI COLOUR SET REVIEWED NEXT MONTH

During a recent visit to the EMI Homebush, NSW, factory, members of Electronics Australia staff were privileged to watch the first EMI colour TV set come off the production line. This set has a number of novel features, particularly in regard to simplification of service. The company has submitted the design as an entry for the Prince Philip Prize for Australian Design. We will tell you all about it in these notes next month.

Every component on the circuit is numbered, the numbers being repeated at the top and bottom of the circuit for easy location. These numbers are repeated on the printed board patterns in the manual, with similar reference scales to aid location. Finally, they are repeated on the boards themselves. Thus a component on the board is quickly located on the circuit or vice versa.

The power supply is a small separate unit mounted in the bottom of the cabinet. It contains one module, and is readily accessible.

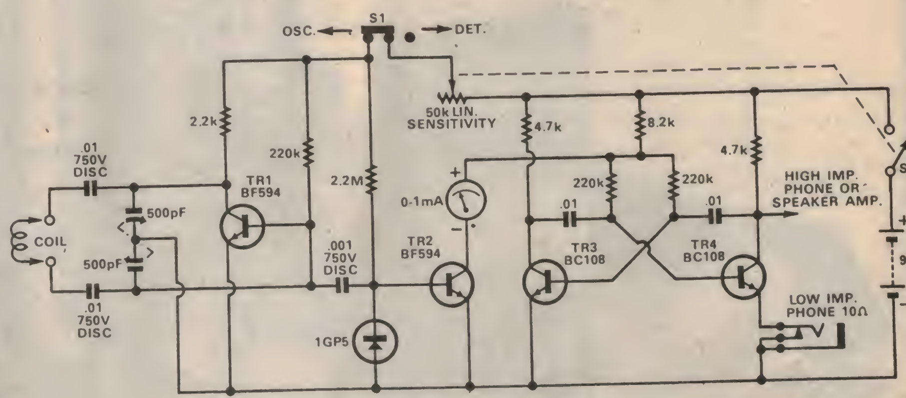
All in all, a set which impresses me as having been designed to give a high order of performance, a high order of reliability, and minimum service costs when faults do occur. Seeing it, and learning about it, has dispelled some of the qualms I have felt about the introduction of colour in general.

Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Tone dip oscillator



Usually, only a small amount of space is devoted to any one item in Circuit & Design Ideas. However, this month, I have an interesting item which I feel is worthy of extra space and although the article has been severely cut, no doubt readers who wish to use the principles involved, will have no trouble in filling in the gaps. Transistor type BF594 does not seem to be known here and a substitute will have to be found. The old trusty BF115 may do the job but one of the BF180 series may be better and could be investigated.

The novel feature of this design is the use of an audio frequency tone to indicate the level of RF energy in the tuned circuit. The tone changes pitch if the RF level changes, so that absorption of energy from the oscillator makes the tone dip lower in frequency. As an absorption wavemeter, the presence of RF energy is indicated by a rise in the pitch of the tone.

The advantages of this feature are: A low-impedance earphone and jack socket replace a moving-coil meter. The operator's attention can be focussed continually on the coupling between the oscillator and circuit under test, without the distraction of watching a meter. The ear can detect a change in pitch at least as easily as the eye can detect a needle flicker. The inertia of a meter needle is such that a dip may be missed through quick tuning, but the audio tone responds instantly.

The heart of the design is a simple Colpitts oscillator using a BF594 transistor. With a choice of four different coils the frequency range 1.2 to 170MHz can be covered.

Sensitivity is controlled by the 50k linear potentiometer. The best adjustment is for a gentle oscillation, but in practice there is inevitably some variation in strength of oscillation over the whole range of the tuning capacitor, so some readjustment of the sensitivity control may be required. The two-position slide switch S1 is used to switch off the RF oscillator, so that the instrument can be used as an absorption wavemeter.

The output from the RF oscillator, basically a constant-amplitude waveform except at the resonant frequency of the circuit under test, is fed into a detector. Transistor TR2 acts as a current amplifier, up to about 1mA, depending on the amplitude of the RF oscillator signal. This current feeds via the 8.2k resistor, and so changes the bias conditions of the multivibrator when there is a change in RF level, thus altering the audio frequency of oscillation.

The collector current of TR2 can also be passed through a 1mA meter if desired. Audio output can be taken via an earphone connected to the emitter of one of the multivibrator transistors. This will be suitable for a low-impedance earphone. Also, an amplifier suitable for driving a high impedance (crystal) earphone or a 75 ohm loudspeaker may be added.

The RF oscillator and detector are both built as a sub-assembly on the tags of the tuning capacitor, and mounted close to the socket for the plug-in coils. It is most convenient to preassemble the oscillator and detector onto the tuning capacitor before it is fitted into the box. Care should be taken to keep component leads as short as possible. The multivibrator is on a separate board.

COIL DETAILS

36-170MHz 18swg TC, exactly 3in, bent into loop and ⅛in each end used for connection.

12-50MHz 26swg enamel, 7 turns close-wound, single layer.

3.6-15MHz 36swg enamel, 30 turns close-wound, single layer.

1.2-5MHz 36swg enamel, 53 turns 1st layer close-wound, 42 turns 2nd layer close-wound.

As mentioned earlier, the instrument may be built with a phone socket and/or meter or 2¼in speaker, and to some extent the choice of output device will decide the size and shape of box needed.

There are one or two points to note when assembling the instrument. The leads of the disc isolating capacitors should be as short as possible, and the discs themselves should not be allowed to touch the chassis. Leads to the coil socket must be kept as short as possible. TR1 also should be positioned so that the leads are as short as possible to ensure the best top frequency performance.

The coils, except the highest frequency one, are wound on 6mm formers with cores. The formers are fixed to a suitable plug, to match the socket into which they are to be plugged. The highest frequency coil is a loop of wire, fixed to a plug. Details of this and the other coils are given in the table.

A length of feeder exhibits multiple resonances which can be used to calibrate this or any other similar instrument. For example, 300 ohm twin feeder usually has a velocity factor of 0.84 and so 4.2m of this feeder will resonate at half wave multiples (when shorted at both ends) at 30, 60, 90, 120 and 150MHz and give calibration check points at these frequencies. The same length open circuited at one end resonates at 15, 45, 75, 105 and 135MHz. The ribbon should be stretched out fairly straight if these figures are to be accurate.

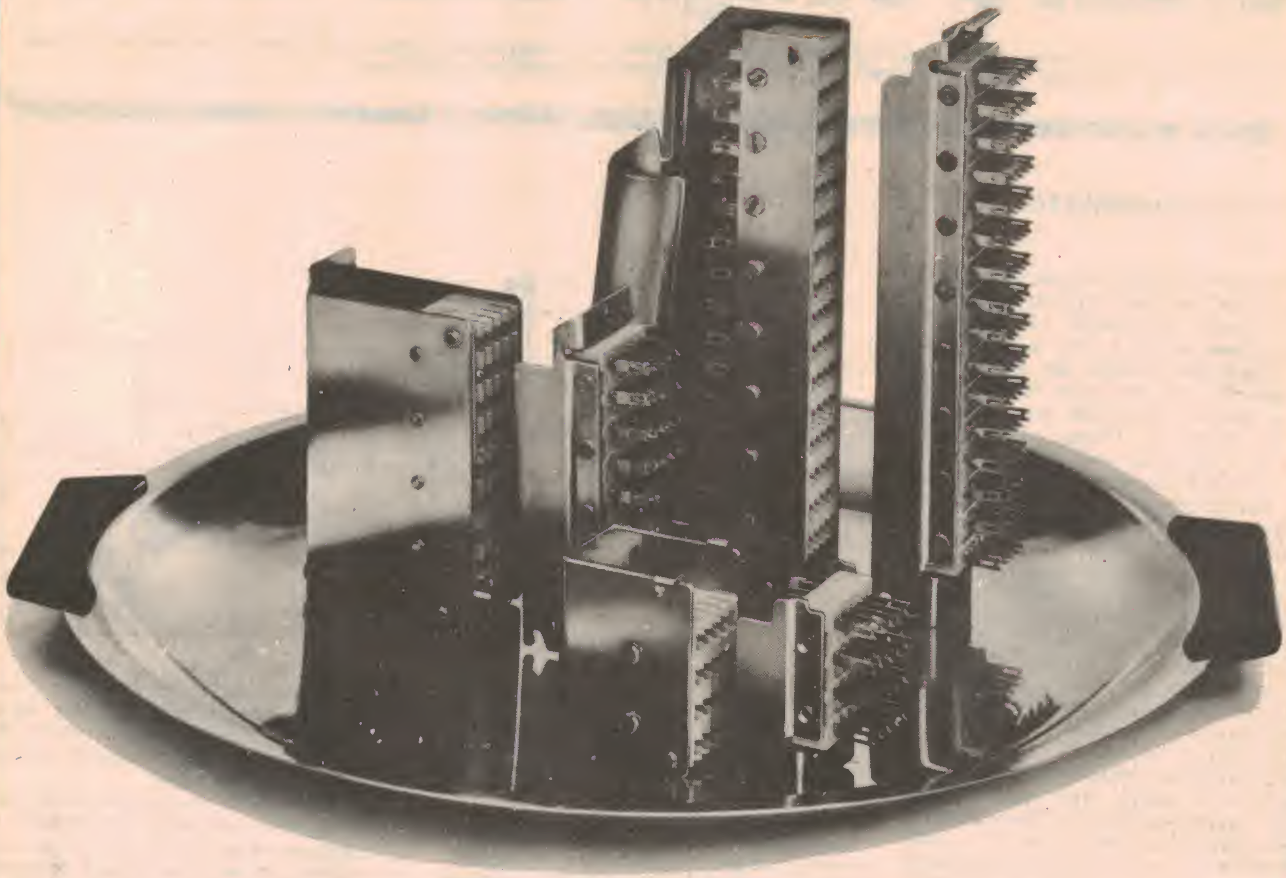
(By Rev P. W. Sollom, OSB, BSc (Eng), PhD, G3BGL, in "Radio Communication".)

Car battery indicator lamp

Your car battery faces its moment of truth every morning, when you turn the key in the ignition. There are clues that alert you to a slowly dying battery — but these are noticed only if you are alert to them.

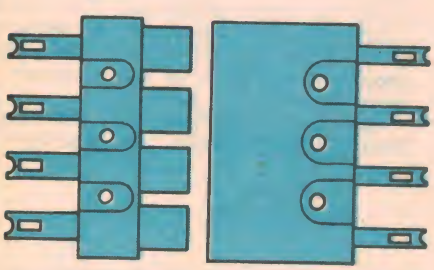
Engineers agree that the best way to test a battery is under load, and that the terminal voltage of a 12-volt auto battery should not fall below 9.2 volts when initially loaded by the starter motor. The light in the checker is designed to turn off whenever voltage drops below that figure. All you do is plug it into your lighter socket before starting — if the lamp flickers or goes out as the starter cranks, your battery needs checking. It is easy enough to do daily, but a weekly check should be often enough.

This is how the circuit works: Silicon



Plessey knife and fork connectors economical...rugged...versatile

Knite and fork contact units
ACTUAL SIZE



These economical multi-circuit connectors are reliability proven and of exceptionally rugged construction . . . they are available in standard 20, 40 and 80 way sizes.

Connector frames are of pressed steel finished in passivated zinc and house either 1, 2 or 4 sets of A.B.S. Green moulded modules (illustrated) each of which accommodates twenty knife or fork terminal assemblies.

The modular construction of these connectors makes them an extremely versatile means of quickly effecting multi-circuit linkage . . . Plessey offers these modular contact units as a separate item and any number of such may be arranged and housed to suit the customer's own alternative housing design requirements.

Plessey knife and fork connectors were originally designed for use in crossbar telephone switching equipment and therefore meet the highest quality standards as demanded by Post Office specifications.

Connectors and modular contact units are available ex-stock. Comprehensive literature is available on request to the Professional Components Division.

Melb.: Zephyr Products Pty. Ltd. 56 7231
Adel.: K. D. Fisher & Co. 223 6294
Perth: H. J. McQuillan Pty. Ltd. 68 7111
N.Z.: Henderson (N.Z.) 6 4189

PLESSEY

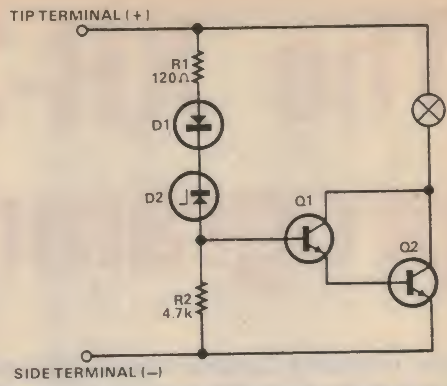
Plessey Australia Pty. Limited
Components Division
Box 2 PO Villawood NSW 2163
Telephone 72 0133 Telex 20384

AC104/R1

diode D1 has an approximate turn-on voltage of 0.6V, while zener diode D2 immediately following it has a constant avalanche voltage of 7.5V. Thus, current has no path through these series diodes until the potential difference across them is greater than 8.1V. The output of the diodes (at the junction of D2 and R2) is applied to Q1 and Q2, which are wired as a Darlington transistor switch. This switch circuit does not conduct until the potential difference between its base (Q1B) and emitter (Q2E) exceeds 1.2V.

Only then does the transistor combination act as a closed switch, allowing current through the indicator lamp. In other words, the lamp will light only when the voltage across the input terminals is high enough to pass through both diodes and switch, which is equal to 9.3V. If the voltage falls below 9.3V during cranking, the lamp will go out, indicating potential battery failure under load.

Construction is simple, with all components fitting snugly inside a standard cigarette lighter accessory plug.

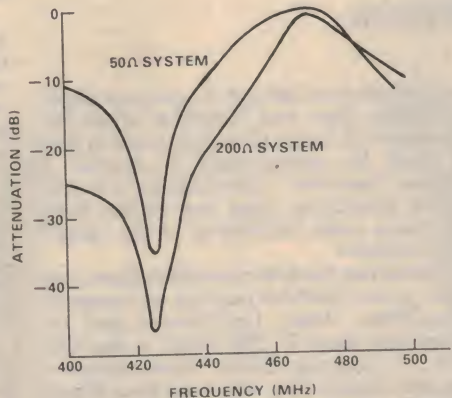


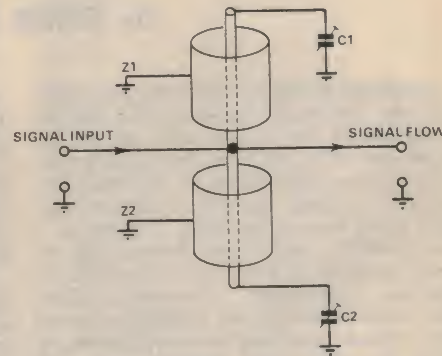
(By Rudolf F. Graf and George J. Whalen, in "Popular Mechanics".)

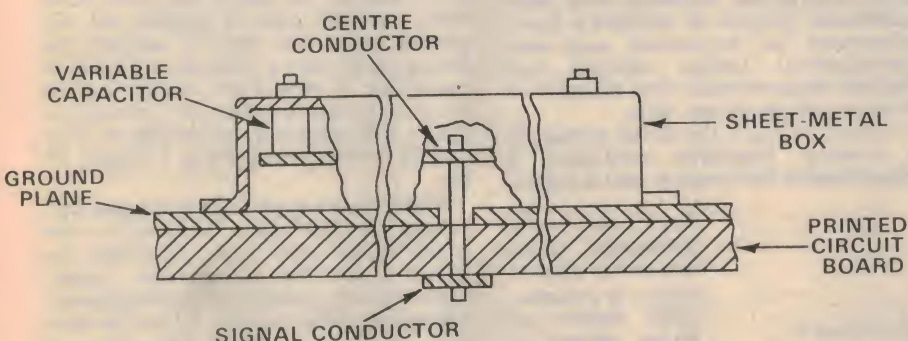
Sharp cut-off filters for UHF

With discrete components too lossy and cavities too bulky, the design of compact, sharp cut-off filters for the frequencies between 200 and 1000MHz poses a problem. We needed a filter that would remove an image frequency at 423MHz without overly attenuating the carrier at 467MHz. Ordinarily this would be done with bandpass filters, several in series being required to get adequate rejection in this frequency band. This means considerable losses.

This problem was solved by using a transmission line filter. Shown in the drawing, the filter has two transmission line sections that form a series-resonant trap for the image frequency and a parallel-resonant passband for the carrier. Operation is as follows: Capacitor C1 tunes transmission line Z1 to series resonance at 423MHz, thus effectively shorting out any signals at the image frequency. At higher frequencies, Z1 is inductive but transmission line Z2, being shorter, is capacitive. C2 is tuned to resonate Z2 with Z1 at 467MHz so the carrier "sees" a parallel resonant circuit, and passes with negligible loss.







As shown in the plot of frequency response, this design easily achieves more than 35dB rejection of signals at the image frequency in a 50 ohm system and more than 45dB in a 200 ohm system.

There are a number of ways that such a circuit can be constructed. The design that evolved uses a long, sheet-metal box with an open side that is clamped to the ground plane of a printed-circuit board, forming the outer conductor of a coaxial line. The centre conductor is a flat bar mounted at each end by a trimmer capacitor, as shown in the drawing. This forms a completely shielded, low-loss, air-dielectric transmission line.

The single structure contains both sections of coaxial line. The signal lead, brought from the other side of the printed circuit board through a hole in the ground plane, attaches to the centre conductor at the point that divides the line into the series-resonant and parallel-resonant sections. Actually, two signal leads are used, one for the input to the filter and one for the output, eliminating a common impedance between input and output that would degrade performance. These leads attach on opposite sides of the centre conductor bar.

(By James Larsen, Richard Dilman and Richard Tverdoch, in "Hewlett-Packard Journal".)

The XR-2240: a versatile programmable timer

Exar Integrated Systems Incorporated of Sunnyvale, California, has recently introduced a powerful new programmable monolithic timer. Designated the XR-2240, the new device has a far-ranging field of applications including precision timing, frequency synthesis and analog-to-digital conversion, to name just a few. This article gives a description of the XR-2240 programmable timer and describes several basic application circuits using the device.

by GREG SWAIN

Monolithic timing circuits were pioneered by Exar Integrated Systems with the introduction of the XR-220 and XR-320 integrated circuits, followed soon after by the introduction of the SE555 by Signetics. As expected, market acceptance for a monolithic timer was enthusiastic. Viewed as a sub-assembly, timers are second only to power supplies in terms of the number of potential applications. Monolithic timers were welcomed into all adaptable timer applications, providing obvious benefits in terms of cost, size, performance, and reliability.

However, these first generation timers do have certain limitations. They are all "one-shot" or "single-cycle" type circuits, and cannot be programmed. In addition, the accuracy and timing range is limited, with typical practical delays of only several minutes — as the delay increases above this figure, accuracy rapidly decreases. The XR-2556, a dual timing circuit containing two independent 555-type timers on a single monolithic chip, was somewhat of an improvement in terms of accuracy and in that it could be programmed to provide a delayed "one-shot." Nevertheless, it is still a first generation timer and suffers from the same basic limitations as the single cycle circuits.

Pioneering the first monolithic timer put Exar in an excellent position to recognise monolithic timer limitations and do something about it. The result is the XR-2240, a programmable timer/counter capable of producing ultra-long time delays without sacrificing accuracy. For most applications, the new IC provides a direct replacement for mechanical and electromechanical timing devices and generates programmable time delays from micro-seconds up to five days.

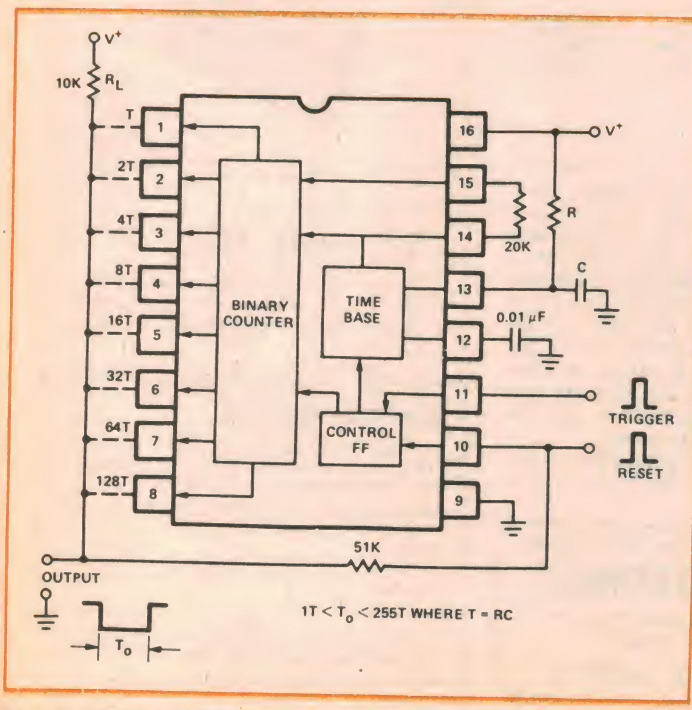
As shown in Fig. 1, the circuit comprises an internal timebase oscillator, a programmable 8-bit counter and a control flip-flop. The basic time delay is set by an external RC network and can be programmed to any value from 1RC to 255RC. In astable operation, the circuit can generate 255 separate frequencies or pulse patterns from a single RC setting, and can be synchronised with external clock signals. Both the control inputs and outputs are compatible with TTL and DTL logic levels.

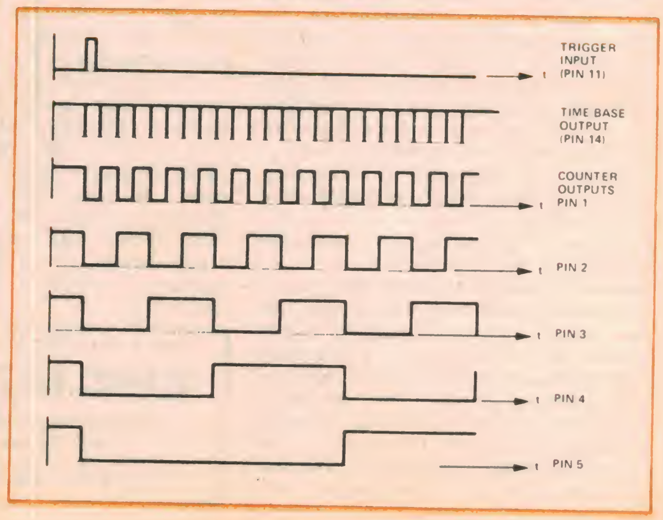
The timing cycle for the XR-2240 is initiated by applying a positive-going trigger pulse to pin 11. The trigger input actuates the timebase oscillator and the counter section, and sets all the counter outputs to "low" state. The timebase oscillator generates timing pulses of period T = 1RC which are fed into the binary counter. The flip-flops in the counter divide the frequency down by counting the clock pulses coming out of the timebase oscillator. The timing cycle is completed when a positive-going reset pulse is applied to pin 10.

In most circuit applications, one or more of the counter outputs are connected back to the reset terminal, as shown in Fig. 1. Wired in this fashion, the circuit will start timing when a trigger pulse is applied and will automatically reset itself to complete the timing cycle when a programmed count is completed. If none of the counter outputs are connected back to the reset terminal the circuit will operate in an astable or free-running mode, subsequent to a trigger input.

When power is applied to the XR-2240 with no trigger or reset inputs, the circuit reverts to the "reset" state. Once triggered, the circuit is immune to additional trigger inputs until the timing cycle is completed or a reset input pulse applied. If both the reset and trigger controls are activated simultaneously, the circuit reverts to the "trigger" state.

Fig 1 (below, left): generalised circuit for timing applications. Fig 2 (below, right) depicts the timing diagram of the output waveforms.





Power supply requirements for the XR-2240 are from 4-15V off a single supply rail connected to pin 16. For supply voltages of less than 4.5V, when using the internal timebase, pin 15 should be connected to pin 16.

The binary counter outputs are buffered "open-collector" type stages, as shown in Fig. 3. Each output is capable of sinking approximately 5mA of load current. At reset condition, all the counter outputs are at a high or non-conducting state. Subsequent to a trigger input, the outputs change state in accordance to the timing diagram shown in Fig. 2. The combined output of the buffer stages will be "low" as long as any one of the outputs is low, allowing the time delays associated with each counter to be summed by simply shorting them to a common output bus as shown in Fig. 1.

Actual programming of the counter is thus a relatively simple process. For example, if only pin 6 is connected to the output and the rest left open, the total duration of the timing cycle, To, would be 32T, where T = RC. Similarly, if pins 1, 5 and 6 are shorted to the output bus, the total time delay would be To = (1 + 16 + 32)T = 49T. In this manner, the total time delay, To, can be varied from 1T to 255T by "or" wiring the counter outputs together.

In precision timing applications, the XR-2240 is used in its monostable or "self-resetting" mode. The generalised circuit connection for this application is shown in Fig. 1. The output is normally "high," reverting to "low" subsequent to a trigger input. It stays low for the time duration To and then returns to the high state. The duration of the timing cycle is given by the equation:

$$To = NT = NRC$$

where T = RC is the timebase period as set by the timing components at pin 13 and N in an integer between 1 and 255 inclusive, as determined by the combination of counter outputs connected to the output bus.

Two XR-2240 units can be cascaded to generate extremely long accurate time delays. In this application, the reset and trigger terminals of both units are tied together as shown in Fig. 4. The total timing cycle of two cascaded units can be programmed from To = 255RC to To = 65,025RC in 255 discrete steps by selectively shorting a combination of counter outputs from unit 2 to the output bus.

For cascaded operation, the timebase section of unit 2 can be powered down to reduce power consumption by using the circuit configuration shown in Fig. 5. The V+ terminal (pin 16) of unit 2 is left open-circuited, and the unit is powered from the regulator output of unit 1 by connecting pin 15 of both units together. In this configuration, the internal timebase of unit 2 does not draw any current, thus reducing the overall current drain by approximately 3mA.

The internal timebase oscillator may also be powered down if the XR-2240 is to be operated with an external clock or timebase and from voltages of 6V or less. In this case, pin 16 is left open circuit and pin 15 is connected to the positive supply. For supply voltages above 6V, the internal timebase can be deactivated by connecting a 1k resistor from pin 13 to ground. The external clock output is applied to pin 14 and, for proper operation, a minimum clock pulse amplitude of 3V is required.

The XR-2240 is operated in its astable or free-running mode by disconnecting the reset terminal (pin 10) from the counter outputs. Two typical circuit configurations for this mode of operation are shown in Fig. 6. In Fig. 6(a), the circuit operates in its astable mode with external trigger and reset signals, and will continue counting subsequent to a trigger impulse until an external reset pulse is applied to pin 10.

The circuit shown is Fig. 6(b) is designed

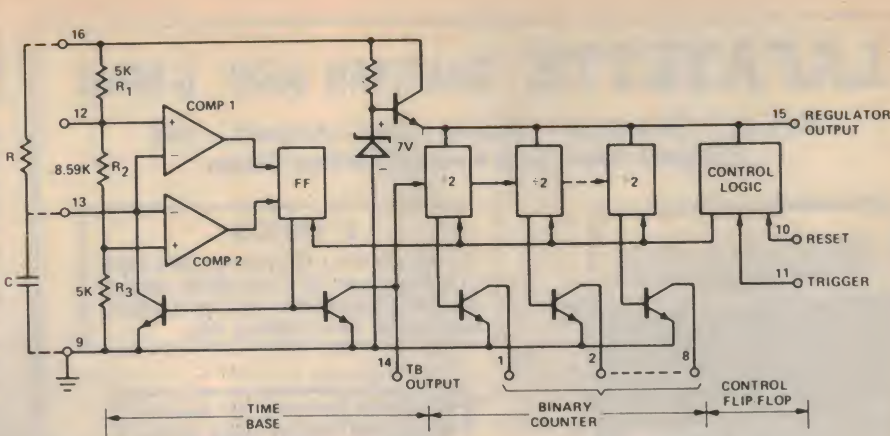


Fig 3 (above): simplified circuit diagram showing the internal circuitry of the XR-2240.

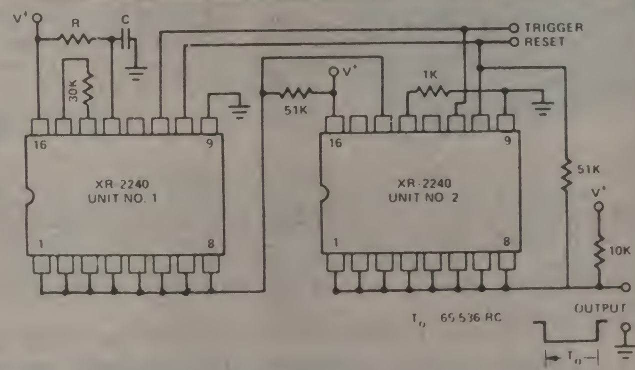


Fig 4: basic circuitry for cascaded operation of two XR-2240s for ultra-long time delays.

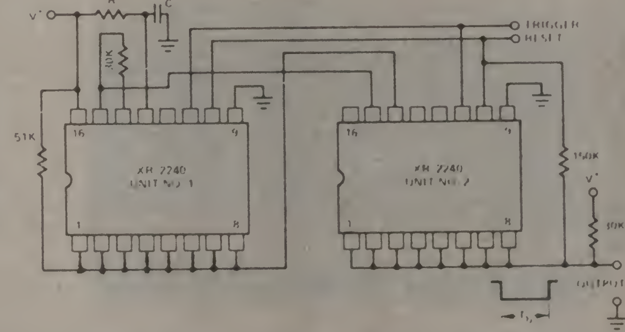


Fig 5: basic circuitry for low power operation of two cascaded timers.

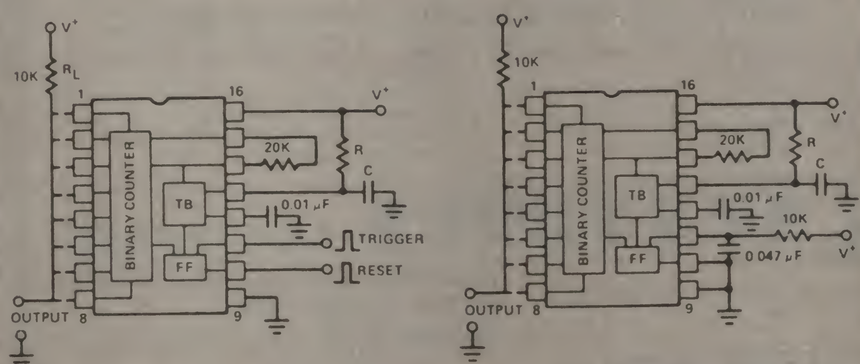


Fig 6(a) (above, left): the circuit configuration for astable operation with external trigger and reset controls. The circuit in Fig 6(b) (above, right) is for free-running operation.

for continuous operation. The circuit self-triggers automatically when the power supply is turned on, and continues to operate in its free-running mode indefinitely. Each of the counter outputs can be used individually as synchronised oscillators, or they can be interconnected to generate complex pulse patterns as shown in Fig. 9. These complex pulse patterns are known as binary pulse patterns, and can be determined directly from the timing diagram shown in Fig. 2. The pulse pattern repeats itself at a rate equal to the period of the highest counter bit connected to the common output bus, while the minimum pulse width contained in the pulse train is determined by the lowest counter connected to the output.

As stated in the introductory paragraphs, the programmable counter section of the XR-2240 can be used to generate 255 discrete frequencies from a given timebase setting. The output from the circuit is a positive pulse train with a pulse width equal to T, and a period equal to $(N + 1)T$, where N is the programmed count of the counter.

Another interesting feature of the XR-2240 is that the timebase can be synchronised at integer multiples or harmonics of an external input sync frequency, by setting the timebase period, T, to be an integer multiple of the sync pulse period, Ts. This is done by choosing the timing components R and C at pin 13 such that:

$$T = RC = (Ts/m)$$

where m is an integer between 1 and 10 inclusive.

The basic circuit for this mode of

ABOUT EXAR SYSTEMS

Exar Integrated Systems Incorporated was formed in 1971 with the aim of providing design engineers with advanced integrated circuits. From the beginning, Exar was determined to become a leader in the field of linear ICs and to avoid becoming another second-source IC manufacturer. Two important decisions were made by the Exar founders: first, all efforts would be devoted to developing bipolar linear technology; and second, the major emphasis in product development would be toward providing advanced linear ICs primarily for application in the industrial communications market.

In following this philosophy, Exar has introduced a variety of functions needed by the analog engineer. Examples include monolithic waveform generators, dual timing circuits, phase-locked loops, and a tow temperature drift VCO.

Exar Integrated Systems is now a multi-national company, and is associated with Toyo Electronic Industries of Japan. The company's products are manufactured in both Sunnyvale, California, and Kyoto, Japan, and are available worldwide. The Australian distributors are A. J. Ferguson Pty Ltd, 29 Devlin Street, Ryde, NSW 2112.

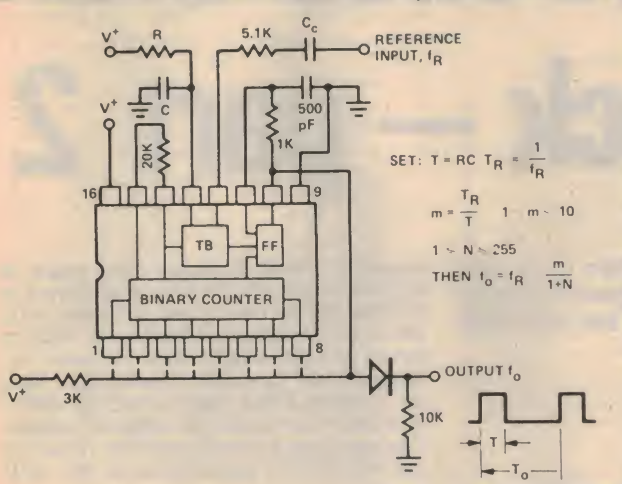


Fig 7: frequency synthesis from a given input reference.

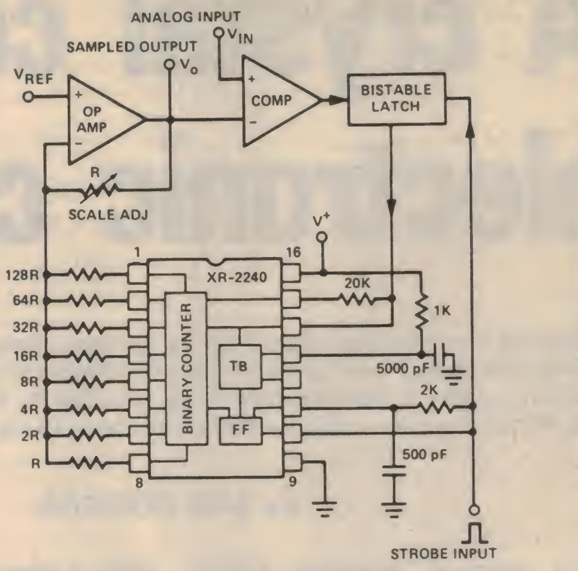


Fig 8: a digital sample and hold circuit using the XR-2240.

operation is given in Fig. 7. If the timebase is synchronised to the (m)th harmonic of the input frequency, the frequency, fo, of the output waveform is related to the input reference frequency, fr, as:

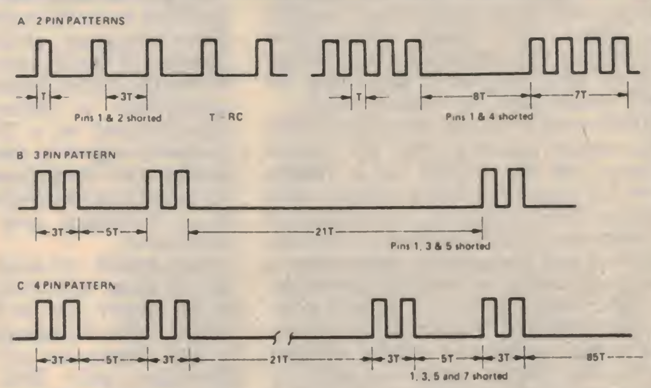
$$fo = fr(m)/(N+1)$$

where m is the harmonic number, and N is the programmed count. As N can be set to any number between 1 and 255 inclusive, the circuit shown in Fig. 7 can produce 2,550 different frequencies from a single fixed reference.

One particular application of the circuit shown in Fig. 7 is in generating frequencies that are not harmonically related to a reference input. For example, by choosing R and C to set $m = 8$ and setting $N = 4$, one can obtain an 80Hz output frequency synchronised to a 50Hz power line frequency.

Two particularly interesting applications for the XR-2240 are in digital sample and hold circuits and in analog-to-digital converters. Fig. 8 shows a digital sample and hold circuit employing the XR-2240. When a trigger pulse is applied, the RC low-pass network between the reset and trigger inputs causes the timer to first be reset and then triggered by the same pulse. The trigger pulse also sets the output of the bistable latch to a high state and activates the counter.

Fig 9: binary pulse patterns obtained by shorting various counter outputs when operating the counter in the astable mode.



The circuit generates a staircase voltage at the output of the op amp. When the level of the staircase reaches that of the analog input to be sampled the comparator changes state, activating the bistable latch and stopping the count. At this point, the voltage level at the op amp output corresponds to the sampled analog input, and this is held until the next trigger signal. The minimum re-cycle time of the system is approximately 3msec.

The basic circuit configuration for an analog-to-digital converter employing the XR-2240 is shown in Fig. 10. The operation of this circuit is very similar to that shown in Fig. 8, the only difference being that the digital output is obtained in parallel format from the binary counter outputs, with the output from pin 8 corresponding to the most significant bit (MSB). As in the previous circuit, the re-cycle time of the A/D converter is approximately 3ms.

And there we have it. From the foregoing, it should be evident that the XR-2240 is an extremely versatile and easy to use device with a wide field of applications in industrial controls, communications, data processing, test equipment, and instrumentation. Individual readers interested in obtaining further information on the XR-2240 programmable counter/timer should contact the Australian distributors, A. J. Ferguson Pty Ltd at their addresses in each state.

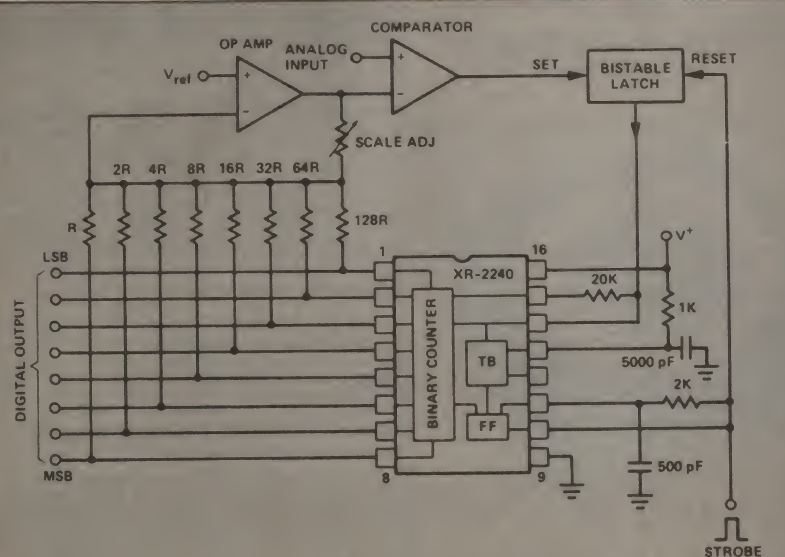


Fig 10: an analog-to-digital converter employing the XR-2240.

A crystal controlled electronic clock — part 2

Following on from the discussion of general design principles given last month, the author here gives details of a practical battery-operated crystal timepiece using a transistorised clock movement. Accuracy can approach one second a month, with a battery life of about 15 months.

by IAN POGSON

After looking at the various building blocks for a crystal controlled clock last month, we are now in a position to examine a practical application of these principles. It will probably be obvious to many readers that there are many alternative possibilities. Nevertheless, the design which we have adopted is one which we believe should meet the needs of many.

Without any further ado, let us take a look at the circuit. Starting with the crystal oscillator, we have opted for a 100kHz crystal and the circuit which we have used numerous times in the past for crystals on this frequency. Circuit constants have been adjusted to suit this specific application. A point worth noting for readers unfamiliar with this circuit, is that it uses a complementary NPN PNP pair of transistors.

The second stage is a binary divider, changing the 100kHz crystal output to a frequency of 50kHz. This divider is similar to a number of binary dividers used later on in the chain, but as it has to operate at a relatively high frequency and under very low current and voltage conditions, some resistor values are lower than for dividers operating at lower frequencies. Also, each 180k cross-coupling resistor is shunted with 47pF. The diodes, instead of silicon types, are germanium, type OA91.

The third stage is an astable multivibrator, dividing by five, thus giving an output of 10kHz. Coupling into this stage is via a 6-60pF variable trimmer, which may be adjusted for the correct amount of drive necessary to realise the required five-times division.

The fourth stage is also an astable multivibrator and is again coupled from the previous stage with a 6-60pF variable trimmer. This stage also divides by five, giving an output of 2kHz. One point worthy of note in this stage, is that the two capacitors forming part of the time constants are not equal in value. More will be said about this in the discussion on adjustments.

The fifth stage is once again a multivibrator dividing by five, to 400Hz. This stage is straightforward and no further comment is necessary.

The sixth stage reverts to the binary method of division. Unlike the second stage, this divider uses silicon diodes. Output from this stage is at 200Hz. The following three stages, seven, eight and nine, are also binary dividers, producing 100Hz, 50Hz and 25Hz, respectively.

At this point, division is complete, it having been explained in the previous article that it was not necessary to divide to a lower frequency, although the movement operates at five beats per second. However, before the output frequency can be used to synchronise a movement, it must be superimposed on a DC component. The composite signal is then capable of maintaining and synchronising the movement. To meet these requirements, the 25Hz is fed to a Darlington pair and then to the movement.

Last month, we dealt at some length on the variables encountered when either a 1.5 or 3V supply was to be used. From the circuit, it may be seen that I have settled for a 1.5V supply for all stages except the Darlington pair. This arrangement has been arrived at after considerable thought.

Conflicting requirements had to be resolved. One was that the lowest possible power should be consumed and this pointed to the use of 1.5V, with the attendant lower current consumption. On the other hand, if we use a single dry cell, the voltage falls steadily throughout its life and the voltage change could give rise to trouble with the astable dividers.

To meet the last problem, it seemed that the best way out would be to have a regulated voltage to supply these stages at least. It would also be wise to make use of this facility for the crystal oscillator in the interests of frequency stability, at least as far as voltage change may influence the frequency of operation. Having gone thus far, it seemed only logical that the binary dividers be fed from the regulated supply. This approach meets the need for reliability and low current consumption at the same time.

This movement from Junghams was used in our prototype crystal clock. The necessary electronics is built into the case.

It may be noted, however, that the Darlington pair is fed directly from the 3V battery supply. As explained last month, the voltage drop across the Darlington pair is such that there would not be enough to drive the movement with only a 1.5V supply.

In order to achieve a 1.5V regulated supply from two 1.5V dry cells, we have used two transistors in a complementary Darlington pair as a variable-voltage zener. In addition to being set to a nominal voltage below that of readily available zener diodes, it can also be made to operate very efficiently. With the circuit as shown and with a pair of brand new cells, the total drain for the clock is just on 1.5mA, dropping to about 0.75mA at the point where the cells are at the end of their useful life and where regulation ceases.

Although I have only referred to two 1.5V cells in series, you will have noticed that in the circuit, four cells are shown in series-parallel. The use of four cells is not mandatory but there are a number of considerations which make it desirable.

Let us assume the use of ordinary "D" size cells, such as the Eveready Silver "All Purpose," or their equivalent. It would also be reasonable to assume that one pair of these cells in series would last for about six months in this particular service. If we use four cells in series-parallel, we can reasonably expect that they will last somewhat more than twice as long, say fifteen months. This is a strong argument in favour of the use of the series-parallel connection.

Another benefit in having two sets of cells in service at one time, is that when the set has reached a voltage where they should be replaced, this can be done one pair at a time, without stopping the clock.

So much for the circuit. Some comments on the choice of components may be useful. Reliability is paramount and so good quality components should be used throughout. All resistors are half watt or less and should be of the carbon film or other stable type. Capacitors may generally be either polystyrene or polycarbonate types. Those NPO types in the oscillator should be strictly adhered to, unless you have some ideas on temperature compensation.

The silicon diodes may be types BAW 62, 1N914, 1N4148, or similar and the two

germanium types may be OA91, or any similar type. The twenty NPN transistors may be selected from types BC548, BC108, BF115, BCY56, or similar types. There are two PNP types and they may be BC558, BC178, 2N3638, etc.

Undoubtedly, the most important component in the system is the crystal. The one which I used is quite an old one, which happened to be on hand. It is a DT cut as near as I can determine, and has gold eletrodes, spring mounted in a type Q10 holder. There were considerable numbers of 100kHz crystals about from disposals sources some years ago and it is reasonable to assume that there are still many of them tucked away in junk boxes. If you have one and it is not one which is free to move in its holder, then it should be worth trying.

If you do not have a suitable crystal, it might be worth looking around for one from disposals sources, etc. On the other hand, crystal manufacturers will make one for you. When ordering, it should be stated that the crystal is to be calibrated for use at ambient temperature, an adjustment tolerance of .01 per cent and 32pF input capacitance.

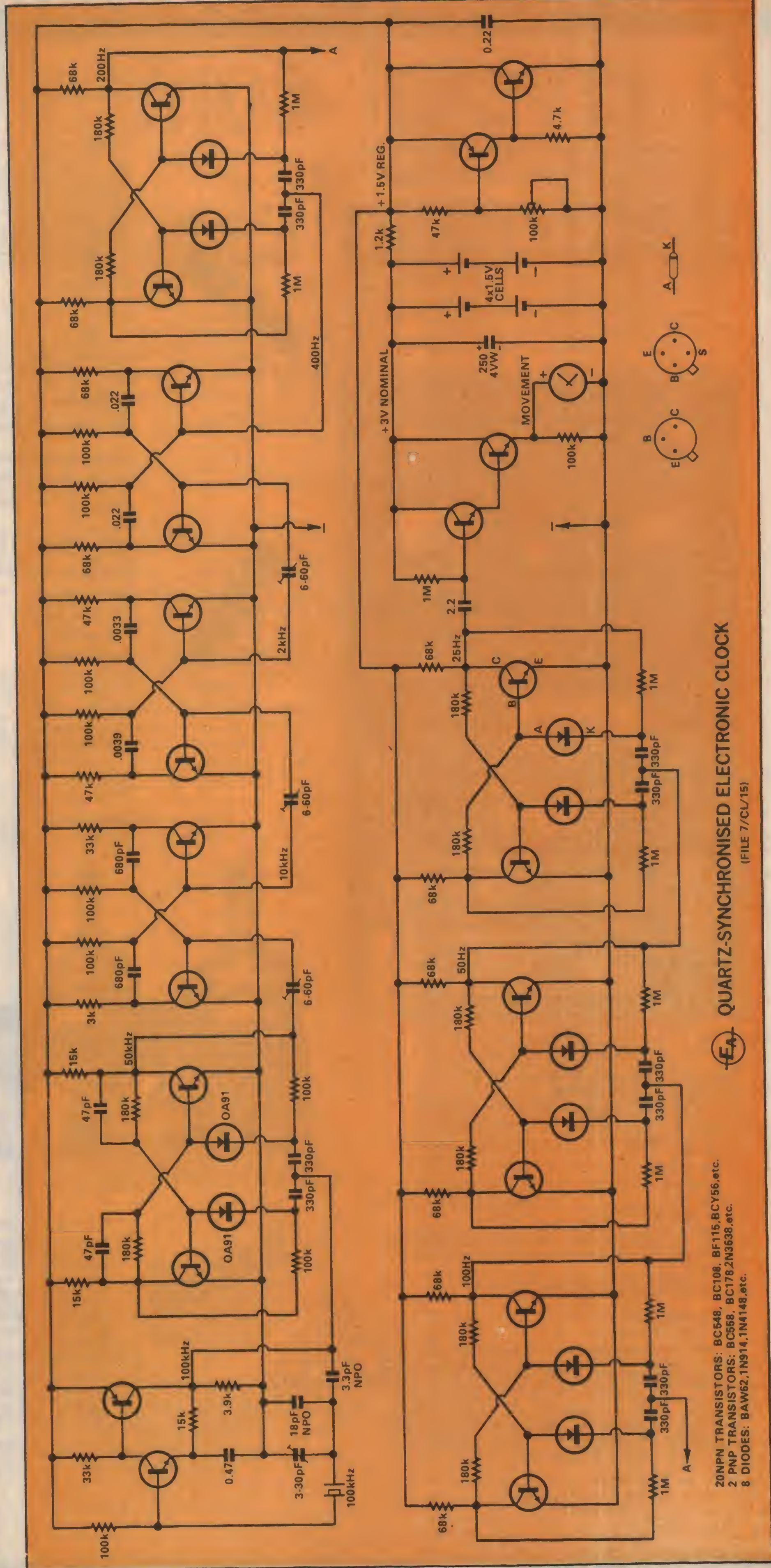
Just which type of dry cells which should be used can be arrived at on economical grounds quite easily and definitely. The ordinary "D" cell which we used has already been discussed from the service life point of view. At a cost of say 15c per cell, a set costs 60c for about 15 months. The red "Heavy Duty" cell is priced at about 20c each, being 80c for a set. It is very doubtful as to whether they would give any extra time in service and so they are not a proposition on these grounds.

Another choice is the gold "Extra Heavy Duty" alkaline cells. According to the makers' charts, this type can be expected to give double the life of the ordinary cells, under our particular conditions. But at a price of about 66c per cell, it may be readily seen that this type is again not a proposition for our purpose. So unless you have some particular reason for using some other type, the ordinary silver cells are the best proposition.

The choice of a clock to be used as the readout for the crystal and divider chain offers many possibilities. There are numerous types available and it should be possible to obtain one which meets all the needs of the individual. Even within one brand name, there are many styles to choose from.

The clock shown in the photographs is made by Junghans and they offer a wide range of styles, with consequent variations in price. I obtained my clock from the Eastwood Hardware Store (a suburb of Sydney), who carry quite a range of this and other makes of similar clocks. It will not be convenient for many readers to visit this establishment, but Junghans clocks are available from a wide variety of outlets and so no trouble should be experienced in getting one. The price of this sort of unit by the way, can be expected to be around $30.

If you wish to reduce costs to a minimum and you are prepared to do some extra work, a very satisfactory movement may be obtained for something less than $10. The movement is a French one, made by Vedette, and may be obtained directly from the importers, Australian Time Equipment Pty Ltd, 192 Princes Highway, Arncliffe, NSW 2205. At the time of writing, I have one of these movements operating on the bench, and in fact I have had another one of the same type in operation for about two years.



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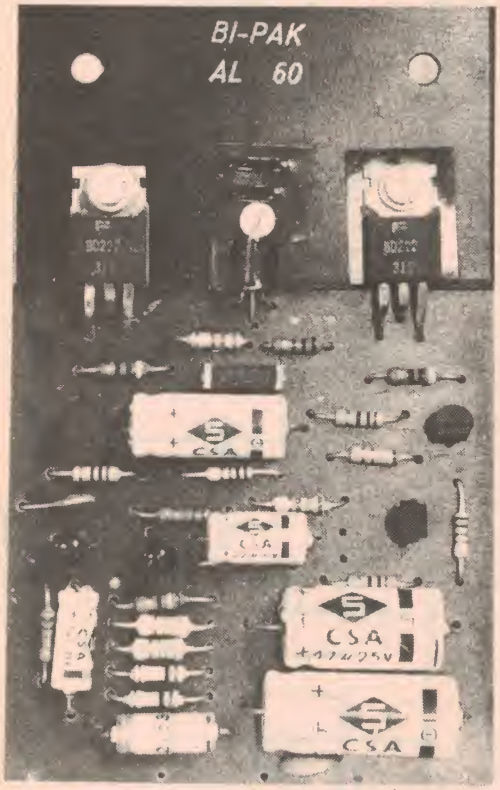

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Specification:

Frequency response	20Hz – 20kHz ±1dB	Bass control	±15dB at 20Hz
Harmonic distortion	better than 0.1%	Treble control	±15dB at 20kHz
Inputs.			
• 1. Tape head	1·25mV into 50KΩ	Filters Rumble (high	100 Hz
2. Radio, Tuner	35mV into 50KΩ	pass) Scratch (low pass)	8kHz
3. Magnetic P.U.	1·5mV into 50KΩ	Signal/noise ratio	better than +65dB
All input voltages are for an output of 250mV.		Input overload	+26dB
Tape and P.U. inputs equalised to RIAA curve		Supply	+35 volts at 20mA
within ±1dB from 20Hz to 20kHz.		Dimensions	292 X 82 X 35mm

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Front Panel only $4.20 extra.

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AL10/AL20/AL30 AUDIO AMPLIFIER MODULES

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power device has resulted in a range of output powers from 3 to 10 watts R.M.S.

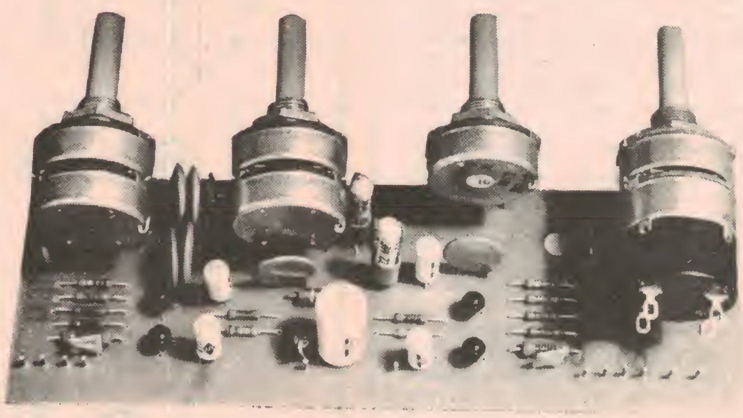
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Power supply to suit $3.20.

PARAMETER	CONDITIONS	PERFORMANCE
HARMONIC DISTORTION	Po = 3 WATTS f = 1KHz	0.25%
LOAD IMPEDANCE	—	8–16Ω
INPUT IMPEDANCE	f 1KHz	100kΩ
FREQUENCY RESPONSE ± 3dB	Po 2 WATTS	50Hz–25KHz
SENSITIVITY for RATED O/P	V8 – 25V R1 8 f – 1KHz	75mV. R.M.S.
DIMENSIONS		3" X 2½" X 1"

The above table relates to the AL10, AL20 and AL30 modules.
The following table outlines the differences in their working conditions.

PARAMETER	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL = 8Ω f = 1KHz)	3 watts R.M.S. Min.	5 watts R.M.S. Min.	10 watts R.M.S. Min.
NORMAL PRICE OUR PRICE	$13.00 $ 8.90	$15.00 $ 9.90	$16.00 $10.90



$17.50

PA12 PRE-AMPLIFIER SPECIFICATION

The PA12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL10, AL20 and AL30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridge while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from right to left: Volume and on/off switch, balance, bass and treble. Size 152 mm X 84 mm X 35 mm.

PRICE $17.50
Front Panels FP12 with knobs $3.20.

Frequency response—20 Hz—50 KHz (—3dB)
Bass control—±12dB at 60 H
Trebel control— ±14dB at 14 KHz
*Input 1. Impedance 1 Meg. ohm
Sensitivity 300 mV
†Input 2. Impedance 30 K ohms
Sensitivity 4 mV

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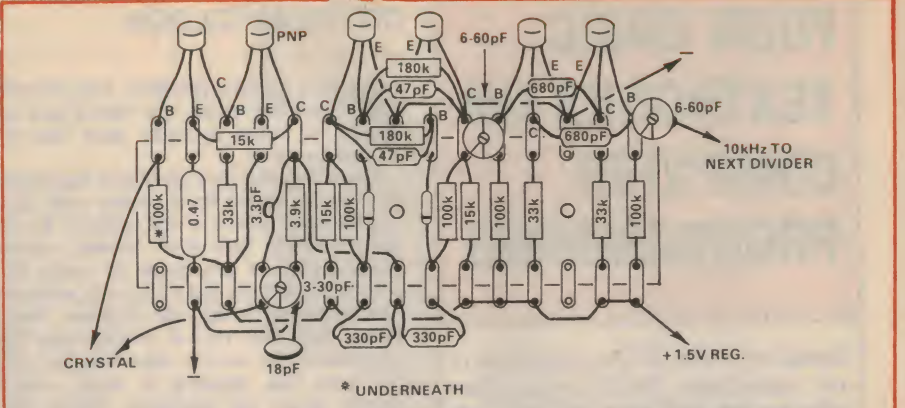
CRYSTAL CLOCK



The complete wiring diagram for the crystal oscillator and the first and second dividers. The dividers divide by two and five respectively.

Another economy alternative is the use of a low priced complete clock in a plastic case, made by Kaiser. These sell for about $12 or less and we tried one of these which was obtained from Radio Despatch Service of 869 George Street, Sydney. This particular unit, although quite satisfactory, does not have a stop / start mechanism and so it is not as easy to adjust precisely to time.

Whatever type of movement you buy, make sure that it is the right kind for the job. It must be a transistor switched balance wheel movement, five beats per second. There are other types on the market, some battery operated — but the battery is used to supply a winding mechanism and does not power the movement directly.

Construction of the electronics part of the clock presents no particular problems but before you set out on it, a decision must be made as to what form the case is to take to house the complete unit. You may be lucky enough to get a clock already built into a suitable case which will house the electronics, but most of the clocks which I have seen are designed to be hung on the wall and as such, are open at the back. Readers may well have their own ideas and the scope is very wide for an imaginative and functional design.

However, we have devised an arrangement which should meet the needs of many readers. The case is relatively simple but has been made so that it can be used vertically on a table or mantel shelf, placed on its back on a table with the face having a gentle slope forward, or hung on the wall, with a small slope downward.

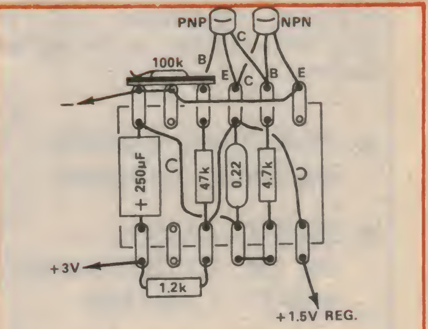
The clock which I bought and that which is shown in the pictures, is a very attractive unit designed for wall mounting. The movement is mounted on a stained and polished board about 17mm thick. I made up a simple box with 12mm thick plywood for the four sides. A back was made from 6mm plywood. The four sides of the box were subsequently veneered and French polished.

As may be seen from the pictures, the box is made with a slope, the slope actually being at the back, with the square face fixed to the back of the board which is part of the original clock unit. Inside dimensions are given in the simple diagram. The 80mm and 57mm dimensions are taken from the back face of the clock board to the outside edge of the box, and also inside at the top and bottom walls. The thickness of the back must then be taken from these dimensions to get the actual clearance available. Four small triangular wooden blocks are glued into the corners to enable the box to be screwed to the back of the clock board.

The back panel is made to be a neat fit inside the back of the box. It may be seen that there are two small blocks in the top corners of the box, set 57mm inside the face, to act as stops for the back panel. On the bottom edge of the back panel I used two round head wood screws, each about 25mm in from each end and screwed into the edge with about ½mm left between the wood and the screw head. Corresponding shallow holes are drilled on the bottom inside face of the box to take the screw heads. This arrangement acts as a kind of hinge.

To fix the back finally in position, I fixed a block of wood centrally at the top edge of the back. A hole was drilled through the top of the cabinet and through the block, and a nut glued to the bottom of the block. A long screw, with fancy head and washer, is then dropped through the holes and screwed into the nut. To allow the unit to be hung on the wall, a pear shaped hole was cut in the back, on the centre line and about 30 to 40mm from the top.

If you are using the same size cabinet as the original, the circuit components may be arranged as shown in the diagrams. Alternatively, the diagrams may serve as a guide when rearranging the layout to suit your different requirements. Component layout is not critical but generally, if it is necessary to make changes, it may be possible to follow the original sequence but simply rearrange the board lengths.

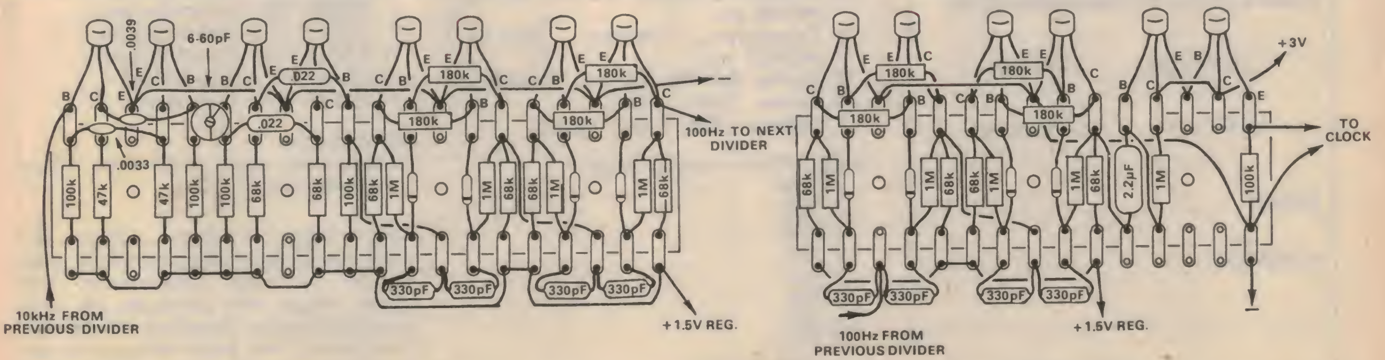


The voltage regulator wiring diagram.

In the original there are four sub-assemblies on miniature tagboard, in addition to the crystal and dry cells. One board, which has fifteen pairs of tags, includes the crystal oscillator, first and second dividers. Wiring is straightforward and other than the usual precautions, note that the output coupling trimmer is mounted on its side so that when the board is fixed in place, it will be possible to gain access to this trimmer should it be necessary.

The next board has twenty pairs of tags and it includes the third, fourth, fifth and sixth dividers. The following board has fifteen pairs of tags and it includes the seventh and eighth dividers and the Darlington pair. Both boards are quite straightforward and need no further comment.

The last board is quite small, having only six pairs of tags. This contains the regulation circuit for the 1.5V supply. Mount the 100k pot so that it is accessible when the



At left is the wiring diagram for the fourth, fifth, sixth and seventh stages, dividing by five, five, two and two respectively. At right is the wiring diagram for the final two binary dividers and the Darlington pair which feeds synchronising pulses to the movement.

CRYSTAL CLOCK

board is in its final position. Also, the other PNP transistor is on this board and care should be taken to make sure that it is correctly wired.

From the rear view picture it may be seen that we arranged the four dry cells in the two bottom corners of the cabinet. We used the Eveready type 714A battery adaptor. These adaptors are made to carry three cells each and we had to cut one section off each adaptor to suit our purpose. We understand at the time of writing that these adaptors have been in short supply but by the time this appears in print, supplies should again be available. There are a number of alternative types of cell holders available and it may be a matter of shopping around for the type you need.

The crystal and its socket are located in the space between the four cells. The socket is held with a wood screw and spacer such that the socket terminals are just about in contact with the wooden base.

As may also be seen from the picture, the tag board assemblies are screwed to the respective sides of the cabinet and held off the wood with ¼in spacers. Interconnecting leads are fitted during the assembly of all the items into the cabinet. Two leads, with insulated alligator clips are run from the Darlington pair to the original battery clips on the movement. A red clip may be used for the positive lead and a black clip for the negative lead.

Before the subassemblies are fitted to the case however, and when wiring is complete, the complete circuit should be bench tested and adjusted. This procedure calls for care and a certain amount of patience. To help in this procedure, I will endeavour to point out any pitfalls or difficulties which may be encountered and the ways that they may be solved or avoided.

To set up and adjust the crystal clock, a CRO is virtually essential. An accurate voltmeter is also necessary to set up the voltage regulator, and a frequency counter can be a great help in setting the crystal frequency fairly closely.

The first job in the setting up procedure is to apply 3 volts from a pair of dry cells to the voltage regulator, before it is connected to the rest of the circuit. Connect the voltmeter between the negative rail and the junction of the 47k and 1.2k resistors. Adjust the 100k pot so that the meter reads 1.5V.

Connect the 1.5V supply to the board containing the crystal oscillator and the first two dividers. The oscillator output may be seen on the CRO by looking across the 3.9k resistor. Assuming that it is in order and if you have a counter, disconnect the CRO and connect the counter across the 3.9k resistor. Adjust the 3-30pF trimmer to bring the crystal precisely to frequency as indicated by the counter. It may be necessary to alter the value of the 18pF capacitor across the trimmer to bring the crystal on frequency.

Connect the CRO and/or the counter across the output of the first divider and check that the output is on 50kHz. At this stage, however, we will assume that all is well, but that you have not been able to make use of a frequency counter. The output from the 50kHz divider is a square wave, rich in harmonics. As such, it may be possible to feed this into a receiver via a small capacitor. Signals should be tunable at each 50kHz interval and one of these may be used to check with VNG on 4.5MHz. It there is a usable signal at 4.5MHz, then zero beat it with VNG by adjusting the oscillator trimmer.

With output established at 50kHz, the next divider has to be adjusted to divide by five, to 10kHz. Look at the output on the CRO from the collector of the second transistor.

LIST OF COMPONENT PARTS

1 Transistorised clock movement (see text)
1 Cabinet to suit
1 100kHz crystal, ambient temp, adj tol .01 per cent, 32pF input cap
1 Socket for crystal
1 Spacer for socket
4 1.5V D size dry cells
2 Holders for dry cells
1 Miniature tag board, 5 prs tags
2 Miniature tag boards, 15 prs tags
1 Miniature tag board, 20 prs tags
8 6mm long brass spacers
20 Transistors, BC548, BC108, BF115, BCY56, etc
2 Transistors, BC558, BC178, 2N3638, etc
8 Diodes, BAW62, 1N914, 1N4148, etc
2 Diodes, OA91, etc
2 Alligator clips, 1 red, 1 black

RESISTORS (½W or less)
1 1.2k
1 3.9k
1 4.7k
3 15k
3 33k
3 47k
10 68k
10 100k
1 100k trimpot
10 180k
9 1M

CAPACITORS
1 3.3pF NPO ceramic
1 18pF NPO ceramic
1 3-30pF Philips trimmer, air or solid dielectric
2 47pF 630V polystyrene
3 6-60pF Philips solid dielectric trimmers
10 330pF 630V polystyrene
2 680pF 630V polystyrene
1 .0033uF 160V polycarbonate
1 .0039uF 160V polycarbonate
2 .022uF 160V polycarbonate
1 0.22uF 100V polycarbonate
1 0.47uF 100V polycarbonate
1 2.2uF 50V polycarbonate
1 250uF 4VW electrolytic

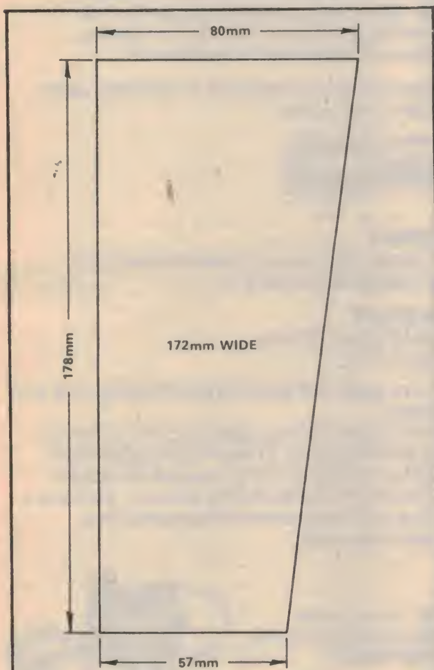
Miscellaneous
Hookup wire, solder, solder lugs, wood screws, etc.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, providing ratings are not exceeded.

Adjust the 6-60pF trimmer for a stable waveform. It should be possible to count five spikes, or small dimples, along the extent of one full cycle of the waveform. If the number of dimples is four or six, then the trimmer should be readjusted to get the proper division. If a counter is available, then it may be used instead of the CRO.

Having set up the first board, connect the second board to the first one and proceed to adjust the next series of dividers. The next divider is similar to the previous one, again dividing by five, to 2kHz. Exactly the same procedure is followed as before. The next divider is the same again, dividing by five, to obtain an output on 400Hz.

Assuming that all is well so far, the worst of the adjustments is over. From here on, all dividers are flip-flops and they automatically divide by two. The next two dividers left on the second board should bring the frequency to 100Hz.



This diagram shows the dimensions of the case constructed for the prototype.

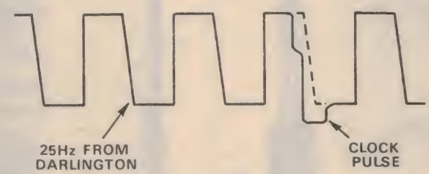
Connect the output of the second board to the third board and it should now be possible to obtain an output on 50Hz from the first divider on this board. An output on 25Hz should be similarly forthcoming from the last divider. Connect the full 3V from the cells to the Darlington pair and it should now be possible to identify the 25Hz superimposed on the DC component across the 100k resistor. It may be noticed that the waveform has changed somewhat in shape but this is normal, due to the high value of the resistance in the output of the Darlington.

The output from the crystal oscillator/divider chain is now ready to drive a clock movement. However, the movement must be adjusted within limits so that it can be synchronised. The movement should be run directly from a 1.5V dry cell, just as it was originally intended, to determine its natural rate.

Set the movement to the correct time, against a time signal and let it run for 24 hours. It is preferable that it should not lose during this time, but up to ten seconds may be tolerable. A gaining rate is to be preferred and I have found that some movements will synchronise quite happily even if the gaining rate is up to 50 seconds and almost one minute per day. However a gaining rate of between about ten and twenty seconds per day should be aimed for. It should not take more than a couple of days to make this adjustment.

With the movement adjusted according to the previous paragraph, we are now in a position to integrate it with the total system. Remove the original dry cell and connect the lugs with regard to polarity, via clip leads to the output of the Darlington pair. Now start the movement in the usual way, by means of the stop/start lever if provided.

To check on synchronising of the movement with the 25Hz from the crystal, connect the CRO across the movement and set up the time base of the CRO to get five cycles displayed on the screen. The display will look similar to the drawing. The pulse produced on the display will also be seen, as shown in the drawing.



A typical pulse pattern, as depicted on a CRO, with locking on a trailing edge.

Locking of the clock pulse with the 25Hz display may be immediate or it may take a minute or two to stabilise. Locking may take place anywhere along the display and it may straddle either a leading or trailing edge. The drawing shows a typical situation, locking being across a trailing edge. Locking by the way, is exhibited by lack of relative movement between the 25Hz display and the clock pulse.

Assuming that the movement has locked in with the 25Hz signal, the clock is now under the control of the crystal. Having established that the circuits are functioning correctly, the various subassemblies may now be fitted to the cabinet.

The challenging task ahead now is to adjust the frequency of the crystal oscillator so that time is indicated over long periods with as little deviation from the true time as possible. To do this, set the hands and start the movement precisely against a time signal. Having started the movement, at the next available time signal any error in starting should be determined and taken into account subsequently. According to the time available, the clock should be carefully observed at short intervals over the next few days or weeks.

If you were fortunate enough to be able to set the crystal against a counter or other known standard, then the initial clock rate should be within a second or so per day of the correct rate. On the other hand, the error may be even tens of seconds per day at first. Large errors may be adjusted for on a daily basis until the error becomes a fraction of a second per day and then adjustment may be made after a week or so. Once a fraction of a second per week is achieved, small adjustments will only be made with great care and consideration.

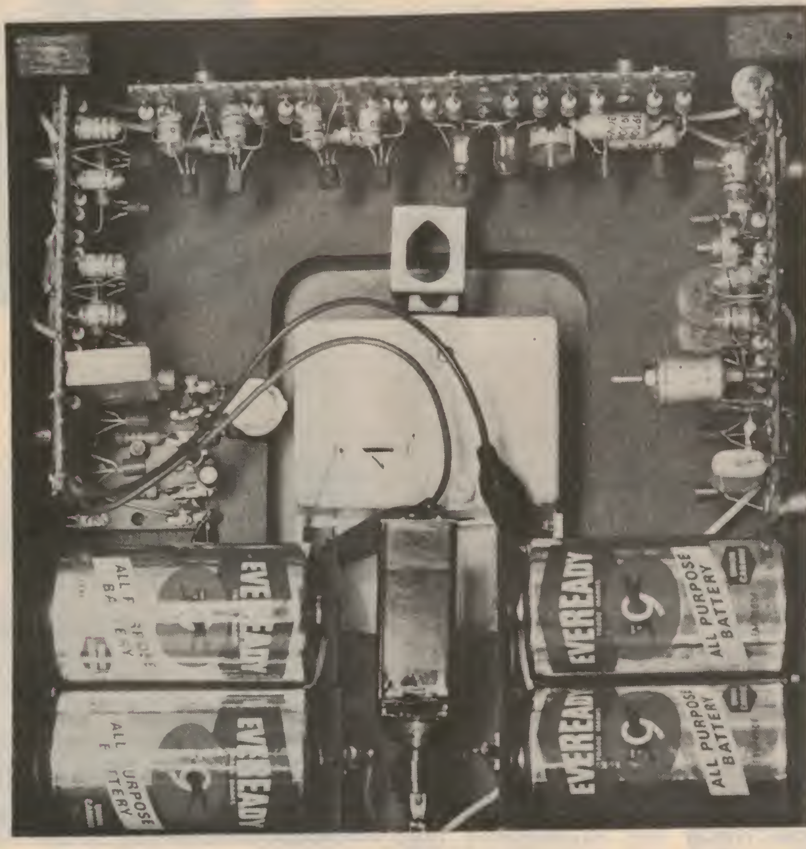
It is difficult to say with any certainty, as I have indicated before, to lay down just what accuracy to expect from this kind of setup. However, if you have a good crystal and you have taken care with its adjustment, a goal to go after would be something like one second per month. If you can achieve this, you will be doing very well but do not be too disappointed if you are not able to achieve and hold this figure.

By now a number of questions may have arisen among readers and I will try to anticipate some of them and offer answers to them. It may be asked whether it would be possible to connect more than one movement across the 25Hz output, thereby providing time indication at a number of points. The answer is, yes.

While I would not be sure just how many can be added, I have had three connected across the one output and they performed as one. Actually, each movement takes up a position on an edge, and there being ten edges available, and assuming that each unit occupied its own edge, then theoretically ten units could be paralleled. This also assumes that two units would not share an edge and I am not at all sure that this is so. Here is some ground where there is ample room for further investigation.

Incidentally, it must be remembered that for each movement added, there will be an increase of about 150uA in current consumption. While the regulator will stand an additional one and perhaps two, the 1.2k resistor would have to be reduced to accommodate extra movements.

While most readers may be quite satisfied to use a movement with the conventional dial, there may be others who would like to have a digital readout. Electronically, this is beyond the scope of these articles but there are many clock movements with mechanical digital readouts. If you can find a suitable clock, with the same type of movement which we have been using, then



This view shows the completed prototype with all tagstrip assemblies in position.

there should be no reason why it should not be used. However, those which have come to my notice are more often than not, a vibrating reed on 300Hz. This may be the subject for a possible later article.

Due to the need to run the divider stages under current starvation conditions, problems may occasionally arise in that a particular stage may not function as expected. This applies particularly to the bistable dividers. Although the design takes this problem into consideration, there are times when, for no apparent reason, a stage may refuse to function properly. The remedy is to first reduce the value of the 1M resistors and only if it is essential, to reduce the value of the collector load resistors. This latter move will increase battery current and is to be avoided if possible.

There may also be cases where the astable dividers are reluctant to divide by five, regardless of the setting of the drive coupling trimmer. The remedy is to substitute a 47k resistor and a 100k trimpot for the 100k resistor in the base of the second transistor. Then, with the coupling trimmer set to about one third of its capacitance, adjust the 100k trimpot for correct operation. The setup may be left as it is, or a resistor substitued for the sum of the 47k and the trimpot setting. In extreme cases, it may be necessary to change one of the time-constant capacitors, such as in the divider to 2kHz.

Assuming that you have adjusted the rate of the movement with a dry cell for a slight gaining rate, as described earlier, a more subtle problem can arise when you have not been able to set the crystal close to the proper frequency. It is possible to have the crystal oscillating at a frequency far enough removed from the correct one that it is not possible to obtain locking of the movement to the 25Hz output.

In these circumstances, perhaps the best way is to exercise a certain amount of patience by looking at the display, on the CRO, of the combined waveforms of the 25Hz and the pulse from the clock. The pulse will be seen to be drifting across the 25Hz component. By experimentally adjusting the trimmer on the crystal oscillator, the drift should become slower and finally lock should be achieved. Having achieved this, the complete system then must be regulated against a time signal, by further adjustment of the oscillator trimmer.

Having got your crystal clock going and adjusted as well as you can, you will experience quite a deal of satisfaction in having built a piece of precision equipment yourself and a unit that will be very useful, either for just telling the time accurately, or for some higher purpose, such as navigation, etc.

It seems that with the components available and the current state of the art, I have taken this project almost as far as I can. However, the question of temperature compensation of the crystal oscillator is one which I am currently investigating. This may take quite a time to resolve one way or the other but I hope to have more to say about this in the not too distant future.

A metal bender for your workshop

Elementary Electronics

Although not strictly an electronics project, this metal bender should find ready application with a great number of electronic project enthusiasts. The time and effort spent in building up the project will obviate the enthusiast's reliance on commercial companies for the metal work for many electronic projects, and will provide the enthusiast with chassis and bracket making facilities for projects of his own design.

by BERT TOOMEY*

The metal bender described here is not difficult to make, and a lathe is not a must for its manufacture. The prototype was made some twelve years ago, and since then has seen constant use in the school workshop. This has been a hard proving ground, and maintenance over the years has been negligible.

The maximum width of material which can be folded by the machine is 400mm, and 18 gauge aluminium is recommended as the heaviest gauge of metal to be used in the bender. On one occasion a student bent a piece of 125 x 3mm steel plate in the machine, but this was most certainly carried out without the author's permission.

The accompanying diagrams, together with the text given below, should make construction of the metal bender a relatively straightforward process. Basically, the device consists of three lengths of angle iron, two hinges, a locking clamp assembly, and a suitable wooden base. No doubt, many constructors will already have the necessary materials stashed away in their "junk" box.

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The logical place to begin construction would be to make up the three pieces of angle iron, as illustrated in Fig 3, according to the accompanying metal work diagram. Angle iron measuring 50 x 50 x 6mm was used in the prototype, although 45 x 45 x 5mm would be equally as suitable. Two 12.5mm diameter holes are drilled in parts A and B (one at either end) to take the locking pins.

Fig 1 shows the locking handle assembly in the "clamp" position. The 4mm pins used to secure the handles to the locking pins are left loose so that they may be removed when bending awkward work, or changing to a slotted clamp bar. Furthermore, the locking handles can be rotated through 180 degrees, enabling them to lock in the outer position. This is a most useful feature when long narrow trays are being folded. Some "fitting" of these handles will be required to achieve the best locking action.

A section through the machine is shown in diagrammatic form in Fig 2. The hinges used in the prototype were 90 x 50mm butt hinges which are secured to both ends of part C (Fig 3) by four 18 x 6mm round head bolts and nuts. It will be necessary to enlarge the holes in the hinges in order to accommodate these bolts.

Above is the author's completed prototype shown mounted on the work bench.

The other section of each hinge is fastened to the wooden base block by four 160 x 6mm bolts which pass right through the timber and through a 3mm thick steel plate let into the wood at the rear. It is essential that the centre of the hinge pin is aligned with the junction point of all three pieces of angle iron used in the construction of the metal bender (see Fig 2). Note that it will be necessary to provide some 6mm of packing material between each hinge and the wooden base block in order to allow for the thickness of part B.

A general arrangement of the major parts is shown in Fig 3. Part "B" is secured to the wooden base block by nine 30mm No. 10 countersunk woodscrews, four in the top section and five in the bottom section. The positioning of these screws is left to the individual constructor.

Parts A and B must be a matched pair with respect to the positions of the 12.5mm holes through which the locking pins are passed (see Fig 2). The 30 degree bevel, which is on part A only, may be ground or filed. Where access to a lathe is not possible, bolts of appropriate sizes may be used to make the locking pins, the locking handles, and the 160 x 12.5mm handles which are screwed into part C (Fig 3). The slot in each 19 x 19 x 35mm locking handle assembly is produced by drilling a hole, cutting with a hacksaw, and filing to fit the locking pins.

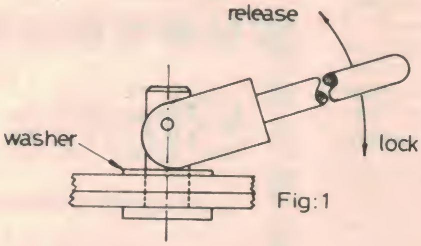


Fig:1

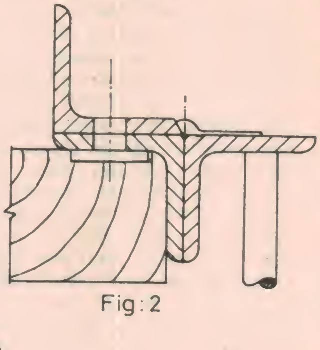


Fig:2

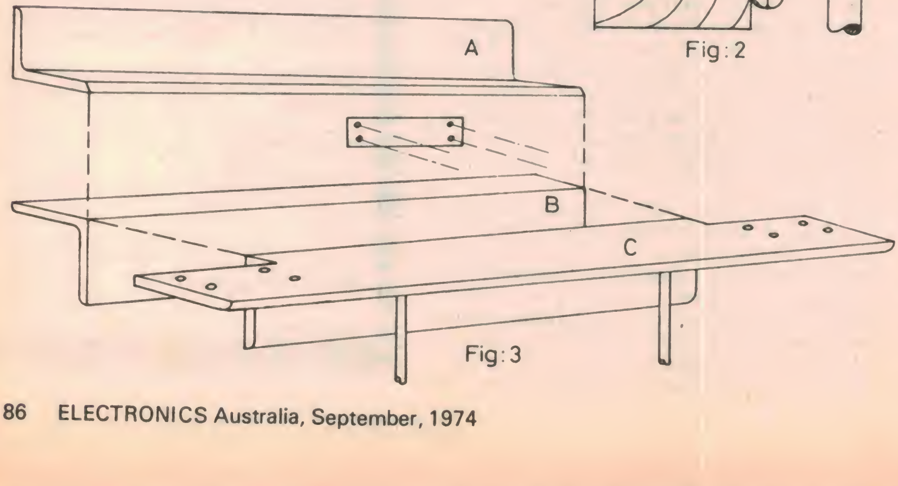


Fig:3

By now, the purists will have noted that the clamp bar (part A) is not adjustable to accommodate metal of various thicknesses. Should this facility be required, it will be necessary to elongate the 12.5mm locking pin holes (in part A only) and mount adjustable stops on the wood at the rear of the clamp bar. A suitable stop arrangement is detailed in Fig 4.

Where it is required to bend shallow trays or fold edges on boxes, a slotted blade, as shown in Fig 5, will be most useful. The slots may be spaced at regular intervals for bending standard size boxes, or spaced to suit each constructor's individual requirements. The slots can be formed by drilling, cutting out with a hacksaw, and filing to a smooth finish (hard work, but worth it in the long run).

Whilst on the subject of chassis, the easiest and most economic method of constructing them is illustrated in Figs 6 and 7. The ends may be secured with PK screws, pop rivets, semitubular rivets, or just ordinary bolts and nuts.

PARTS LIST

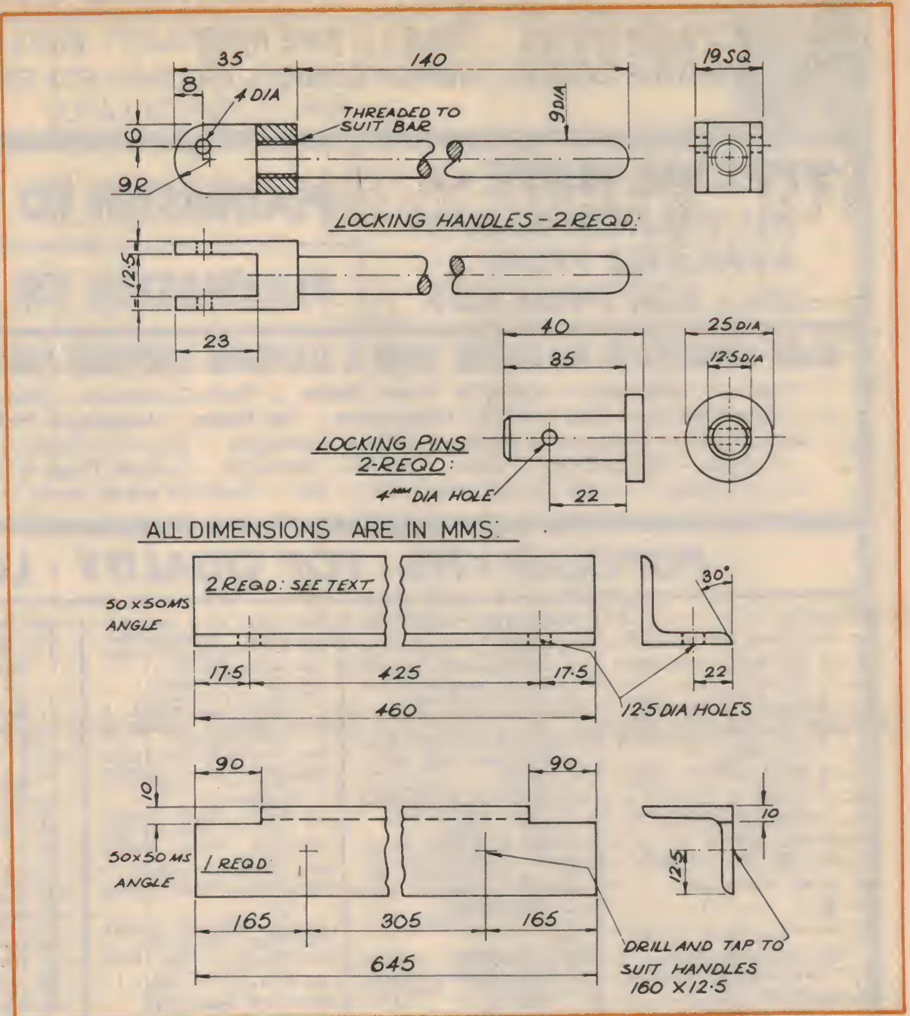
1 piece of hardwood, 700 x 150 x 50mm
1 645mm length of 50 x 50 x 6mm angle iron
2 460mm lengths of 50 x 50 x 6mm angle iron
2 35mm lengths of 19mm sq steel bar
2 150mm lengths of 9mm dia steel rod
2 40mm lengths of 25mm dia steel rod
2 160mm lengths of 12.5mm dia steel rod
2 20 x 4mm round head steel rivets
2 90 x 50mm butt hinges
8 16 x 6mm round head steel bolts and nuts
8 160 x 6mm bolts and nuts
9 30mm No. 10 steel wood screws
2 12.5mm dia steel washers
2 90 x 50 x 3mm steel plates

Note: the above list specifies those parts used in the prototype. Of necessity, some of these parts required machining. Alternative materials may be used by those constructors without access to a lathe (see text).

Two alternative methods of mounting the completed metal bender are suggested. The first, most obvious, suggestion is to fasten the bender by bolting the wooden base block to the workbench. However, the author has found it more convenient to secure the bender to the bench using two G clamps. This enables the device to be removed when not in use, thereby enabling more efficient use of available bench space.

The dimensions shown in the accompanying diagrams are as measured from the original prototype, and may be varied to suit each individual's requirements and the materials on hand. For those people who have access to full workshop facilities, deluxe improvements would be to grind the working surfaces of parts A and B and have the bevel of part A cut on a milling machine.

At the beginning of this article, it was stated that the metal bender is not difficult to construct. This is correct, but a fair amount of time and some adjustments will be required to achieve optimum results. Once completed, it will give good service, becoming an asset to anyone willing to spend the time making it.



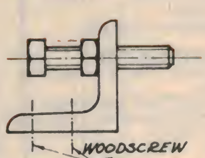


Fig:4

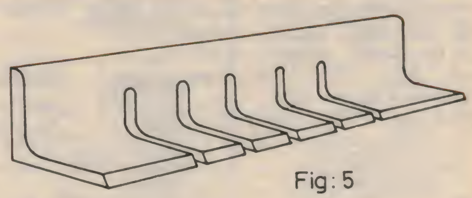


Fig: 5

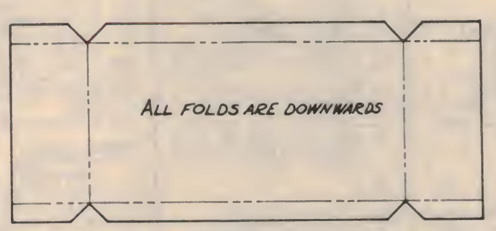


Fig:6

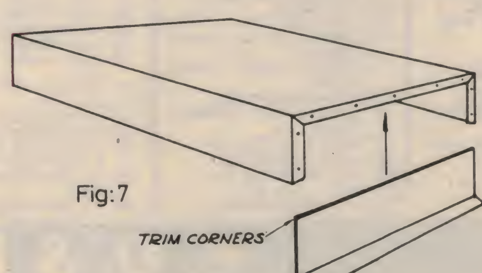


Fig:7

Elementary Electronics
How Does It Work?

A new section entitled "How Does It Work" commences with this issue. If there is anything electrical or electronic which puzzles you, write in and ask us how it works.

Automotive Ignition Systems

An automotive ignition system is one of the most reliable of all electrical systems. Note the number of cars on the road today — very few break down, and fewer still due to ignition failure.

The ignition system can be separated into two sections — the "low" voltage and the high voltage section. The low voltage section consists of the battery, ignition switch, coil primary, breaker points and capacitor. The breaker points are alternately opened and closed by cam geared to the motor crankshaft, being opened once for each firing stroke.

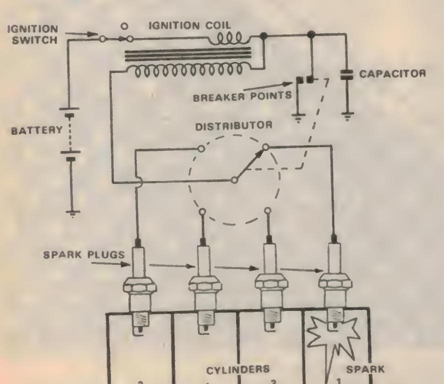
The battery and ignition switch should be self explanatory. From the ignition switch, current flows through the breaker points to vehicle chassis. Across the points is a small capacitor — usually about 0.2uF. This capacitor has a vital function, and one which is not often understood.

When the points are closed, a current flows through the primary of the coil, producing a magnetic field in and around the iron core. The magnetic flux in the core can be considered as a form of stored energy, which is defined largely by the number of turns on the primary winding and the limit to which the current through it can rise with the points closed.

When the distributor points are subsequently opened, the current is interrupted, the magnetic field collapses and a sharp spike of voltage is induced across the primary winding. The magnitude of this voltage spike depends on the inductance, and therefore the number of turns on the primary winding, and on the rate of collapse of the magnetic field.

The rate of collapse, in turn, is dependent on the reactive and resistive properties of the ignition coil as a whole and, no less important, on the conditions which obtain at the breaker points as they open.

As the points open, the large induced primary voltage, caused by the collapsing field, tends to produce an arc across the breaker point gap. Any such arc tends to sustain the current through the primary winding and, in so doing, slows the collapse of the field and diminishes the peak amplitude of the voltage spike.



A conventional (or "Kettering") ignition system, shown for a negative-to-chassis vehicle.

In addition, it causes severe burning of the breaker points, with a consequent limitation on their service life.

These problems are minimised by connecting a suitably chosen capacitor across the breaker points. When the points are closed, the capacitor is shorted out and is therefore completely discharged.

At the instant the points open, the capacitor appears as a short circuit, because there is no voltage across it; what is more, voltage can appear across it only at the rate at which the capacitor can be charged. Naturally, the initial lack of voltage across the opening breaker points inhibits the formation of an arc.

The value of the capacitor is quite critical and its choice is part of the overall design of the ignition system.

If too small, it charges too rapidly and the voltage across the still opening points rises fast enough to produce a residual arc.

If the capacitor is too large, its own charging cycle is so extended that it prolongs current activity through the ignition coil primary. In addition to retarding the collapse of the field, this may modify the timing and nature of the spark and create a second arc when the contact points close on a, perhaps, still significant induced primary voltage.

When the magnetic field is collapsing, the induced primary voltage is approx. 200.

The ratio of primary to secondary turns in an average coil is about 1:100 and, since the collapsing magnetic field induces a voltage in both windings simultaneously, it would seem that the voltage in the secondary should be approximately 100 times that of the primary. This is in fact so and the average ignition coil would have a secondary voltage of about 20,000 volts.

The high voltage section of the ignition system consists of the secondary of the ignition coil, the distributor, the spark plugs, and the high voltage cable which connects them all together.

The secondary voltage is transferred via heavily insulated cable to the distributor, which is actually a single pole, multi position switch driven by the engine. The number of "switch positions" equals the number of cylinders.

As the rotor of the distributor travels around the contacts, it transfers the high voltage from one spark plug to the next in the correct sequence, thus igniting the gas in the cylinder, as the breaker points open.

The spark plug is merely a pair of heavily insulated electrodes which screw into the cylinder, so they are in intimate contact with the petrol/air mixture drawn into the cylinder from the carburettor. One of the electrodes can be bent slightly so that the gap between the pair can be lessened or increased. Having the right gap between the electrodes is of utmose importance if the engine is to operate correctly.

Classical Recordings

Reviewed by Julian Russell

Walton and Shostakovitch — superb recording

WALTON — Cello Concerto.
SHOSTAKOVITCH — Cello Concerto No. 1. Paul Tortelier (cello) with the Bournemouth Symphony Orchestra conducted by Paavo Berglund. EMI Stereo ASD 2924.

The Walton Concerto is a mellifluous work, sometimes even juicy, and nearly always without the lean energy of the First Symphony or the Viola Concerto. Tortelier plays the two outside movements without comment, so to speak, though he misses none of their lyricism. The Scherzo which separates the two is more like the product of what one might call the composer's middle period, though even here juicy harmonies persist in many bars. It is fiercely difficult for both soloist and orchestra who both perform magnificently. The sound too is excellent, the orchestra delivering the most complex score with a clarity of detail that has often been missing in the Bournemouth's recordings since their altogether admirable Scheherazade (Rimsky-Korsakov) some years ago.

Tortelier opens the Finale eloquently with a beautifully intoned and phrased elegiac melody which Walton works into a set of variations, though he calls them "improvisations". Two of the variations / improvisations are for unaccompanied cello while, in another, the cellist is silent. Here the orchestra chatters away in passages sometimes reminiscent of Hindemith at his busiest though, even under this influence, Walton's style is still unmistakeable. This orchestral episode is followed by the second unaccompanied variation, an impassioned cantilena delivered with outstanding tonal beauty by Tortelier, a thrilling introduction to a relaxed ending. The performance, should interest not only cello students but all those whose taste for more or less contemporary (late 1950) music doesn't regard melody as a dirty word.

In the Shostakovitch, Tortelier faces the stiffest imaginable competition from the Rostropovitch premier recording of the concerto with Ormandy and the Philadelphia back in 1960 for the old Coronet / CBS label. Rostropovitch gave perhaps a bigger-boned performance of the two outside movements, which however never succeeds in dwarfing Tortelier's. And in my opinion Tortelier is unmatched in the second (moderato) movement. It is also worth considering that the engineering of the new EMI issue is very much superior to that of the old Coronet, though in its time the latter was considered very good — and still wears well. The concerto's first theme sounds, at first, like a distant relative of a Rachmaninof Finale, but it is later developed with typical Shostakovitch vitality and colour. In this movement the first horn has some diabolically difficult passages which the Philadelphia player made quite a feature of the Coronet recording. However the Bournemouth player, though just a shade below this class, is by no means put to shame and never has one worried about whether or not he will keep his tone steady. (On the Coronet, by the way, the Shostakovitch was coupled with the same composer's First Symphony.)

The Finale is another of Shostakovitch's presto movements though it is marked allegro con moto. It requires and receives admirable accuracy from soloist and orchestra. A short phrase is repeated stridently until it has an almost hypnotic effect. It is one of the composer's hammered assertions that admits of no contradiction or obstacle to a triumphant culmination.

Despite all the superlative things that might be said about the Rostropovitch disc, if you are looking for a splendid recording of the two best full-scale cello concertos of recent years I can warmly recommend this Tortelier-Berglund performance. Berglund and his alert and responsive orchestra are always in complete accord with Tortelier and, as I wrote above, the engineering is great.

* * *

HANDEL — Music for the Royal Fireworks. Concerto in F for horns, oboes, bassoon and strings. Concerto in D for a similar combination but using two instead of four horn. Concerto in D for trumpets, horns, timps, oboes, bassoon, strings and organ. English Chamber Orchestra conducted by Raymond Leppard. Philips Stereo No. 6500 369.

For generations performers, audiences and critics have been in dispute about just how Handel's music should be played. Ornamentation, double-dotting and instrumental combinations are the matters on which opinions differ most. Every annual crop of "Messiahs" brings with it its crop of letters and articles on the same subject. Some support this edition, some that. Some like large orchestras, some small. This lack of unanimity of decision sometimes produces odd results, such as when a singer improvises one ornament while the orchestra simultaneously plays another. The reason for all that preamble is as follows:

Back in 1959 Charles Mackerras edited and conducted a version for Pye of Handel's Music for the Royal Fireworks, an exercise that presented many problems, for Mackerras needed for his version no fewer than 26 oboes, 14 bassoons, 4 contrabassoons, 2 serpents and other instruments. The recording sessions started at about 11 pm because before that time, when London's concerts and operas could be assumed to have finished, no such number of musicians could be assembled. Where on earth, even in London, would one find 26 oboists of the quality Mackerras demanded at liberty to assemble for a recording session at any other time? The recording was made in the open air at the Festival Gardens at Battersea, the nearest contemporary equivalent to the Vauxhall Gardens of Handel's day.

The King (George II) had let Mr. Handel know that to celebrate the peace of Aix-la-Chapelle he wanted his fireworks to be let off to "martial" music. The king added that he hoped there would be no "fidles." Handel, however, wanted them but to humour the king used instead 24 oboes, 12 bassoons, and the rest made up of a combination very similar to that used by Mackerras.

Thus Mackerras had every right to claim that his recording of the music, which was, by the way, accompanied by the sound of bursting fireworks, was the true original, played the way Handel had wanted it.

But had he? According to Raymond Leppard's sleeve notes to his recording of the Fireworks Music under review, Handel, despite the king's hint about "fidles", braved royal disapproval and included 40 string players among the other 60 martial instruments, mostly wind, suitable for outdoor performance.

The occasion was not an unqualified success. Mr. Leppard notes that the music lasts only 30 minutes and that the band started to play at 6pm and that the celebration did not finish till just before 11. From this he deduces that there must have been many fireworks, long gaps in the celebrations, or else Handel added other music of which we have no record (no pun implied).

Enid Gibson, who provided the sleeve notes for the Mackerras recording, wrote that many of the fireworks went off at the wrong time, failed to go off at all, and a large building was set on fire. She doubts if very much of the music was heard at all.

So, at present, the situation rests with Mackerras' disc still making a grand row and Leppard's conforming much more closely to the printed score most musicians have come to know. The only obstacle in the way of you paying your money and taking your choice is that the Mackerras version has long been deleted from Pye's catalogue and Leppard's has just been issued by Philips in Australia. I am glad, however, that I kept the Mackerras version, not only for the purpose of comparison but also for enjoyment of its sheer exuberance. Both he and Leppard pay due respect to Handel's sturdy rhythms and there is little difference in their choice of tempos and the music's Handelian vitality. Both versions might well be described as noble, each in its own way. Mackerras coupled his performance with Handel's Concerto a Due Cori (Choirs) in F Major: Leppard uses three concertos for various combinations.

I have no hesitation in recommending Philips' new issue. Indeed the only quibble I have about it is that the engineering often tends to thicken in the inner voices. Otherwise it's all grand music.

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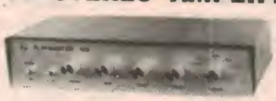

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CLASSIC RADIO

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LEHAR — The Merry Widow. Elizabeth Harwood (Hanna); Rene Kollo (Danilo); Zoltan Kelemen (Mirko); Werner Hollweg (Camille); Donald Grobe (Cascada); Werner Krenn (Raoul) and others with the Berlin Philharmonic Orchestra and the German Opera Chorus of Berlin conducted by Herbert von Karajan. DGG Stereo No. 2707 070 (two discs). An elegantly designed brochure accompanies the set.

Last December my old friend Lindsey Browne who writes a weekly music column for the Sydney Sun-Herald recounted the following conversation which I quote — from memory. Music critic Sir Neville Cardus in London phoned avant garde composer Karl-Heinz Stockhausen in Cologne and asked him: "Karl-Heinz, how much would you charge me and how long would it take you to teach me to write music like you?" Stockhausen replied: "To anyone of your eminence, Sir Neville, I would make no charge and it should take about six months." "Thanks very much," said the wicked Cardus. "But before you go, tell me, how long would it take you to teach me to write music like Lehar?" The only answer was a thump as the receiver was banged down.

I quote this by way of not having to make any excuses for including a recording of The Merry Widow in a column of classical records reviews. To listen to this work should not be beneath the dignity of the most highbrow of musicians.

This new Karajan issue is easily the best sung recording of the operetta that I have ever heard. Perhaps Rene Kollo puts a little too many of the qualities of a heldentenor into the role of Count Danilo. But there are no Richard Taubers around these days and Kollo's performance is not to be scorned. Elizabeth Harwood makes as delightful a Hanna as it would be possible to imagine. True, both these singers do not always seem to be getting all the fun they could out of their roles. Their style smacks rather of Bayreuth than Vienna. And this applies to some of the other members of this really outstanding cast. But I think some of the blame for this rests with the conductor, Karajan, who, so far as I know, has never been noted for displaying a sense of humour, at any rate in his music. And his imperious disciplining of players and singers under his direction is now well known. Indeed, his preference for slow instead of lively tempos is also just as well known.

But under Karajan the Berlin Philharmonic is at the very top of its form with seductive string tone, firm brass and dynamic inflections that could not be more subtle. The chorus too is fine; indeed I have never heard better in any recorded operetta. But it soon becomes obvious that Karajan's main interest is in his orchestra and, contrary to most DGG recordings which as a general rule favour forward placing of the voices, the reverse here is true.

This is also evident in the cutting of the spoken dialogue, which, though it is in German, has been reduced to what might be described as mere conversational hyphens between musical numbers. This is another factor that deprives the "Maxim's" scene of much of its customary animation. And if you understand German you will find a good deal of the drama and continuity missing.

The set is most elegantly got up. The box has a crimson watered-silk cover just like the walls of the pre-war Maxim's restaurant in Paris which might still be similarly decorated for all I know. However the beauty of the singing and orchestral playing goes a long way towards compensating for the other imperfections I have mentioned above.

But I did miss one of the highlights of the work, the duet "Zauber der Hauslichkeit" which for some unexplained reason was omitted from the production, though the third act cakewalk has been included, and very welcome it is, too.

★ ★ ★

BRAHMS — Symphony No 1 in C Minor. Concertgebouw Orchestra conducted by Bernard Haitink. Philips Stereo No. 6500 519.

This new issue of Brahms' First Symphony faces much stiff competition from other companies and even from its own. Every conductor worth mentioning seems to have recorded one at least of the four symphonies during the last very few years. Yet this present recording can stand up to any I've heard by any other conductor or orchestra. The competitors are far too many to mention without doing someone or other an injustice, so many are in the top class. It is a matter of picking the orchestra / conductor combination you have always liked and settling for that. Indeed among the top orchestras' and conductors' recordings of Brahms today, it is difficult to go wrong. Just pick your favourite.

But if you haven't already got a Brahms' First in your library I can strongly recommend this new one.

I think most readers of this column have had so much Brahms offered them and examined in detail by me in the past that any more would be a little like forcible feeding. I shall therefore content myself with writing about this new one that the great Concertgebouw Orchestra is in quite wonderful form. Haitink holds everything together with all his customary intense concentration that, however, does not prevent him from doing full justice to the composer's more feminine movements; and the sound is first rate. You may for one reason or another prefer Klemperer, Barbirolli, Boult, Bernstein, Smidt-Isserstedt . . . the list could be made almost inexhaustible. And you might well run into a fine performance that has been deleted. All I can do is to repeat my recommendation of the Haitink / Concertgebouw and leave the decision to you.

There is an alternative of course. You can always spend a couple of weeks listening to all the others.

★ ★ ★

HAYDN — String Quartets in E Flat Op. 33, No. 2. In F Op. 3, No. 5, and D Minor, Op. 76, No. 2. Janacek Quartet. Decca Ace of Diamonds series No. SDDA 285.

Many musicians consider the D Minor Quartet among the finest music for this medium that Haydn ever composed. It gets its nickname "The Fifths" from its first movement which is built on that interval. This particular movement is outstanding in a work that is in itself one of the landmarks in string quartet writing. It is a movement of irresistible passion interrupted here and there by a lighter mood. The second movement makes a perfect contrast in its unfettered amiability. Then we come to the Menuetto, which has also acquired a nickname, the "Witches' Minuet," because its strict canon between violins in octave and the other two instruments also in octave produce a very strange sound indeed. It is perhaps the most stark movement Haydn ever wrote — as bare as Eve before the Fall. The Finale has in its first subject a distinct Hungarian flavour while the second subject is amusingly reminiscent of a donkey's hee-haw.

The E Flat is a much earlier work, nearly 20 years separating it from the previously mentioned D Minor. It is a much lighter work — indeed its nickname (and how many Haydn works have nicknames would be hard to guess) is "The Joke" for some obscure reason about a bet the composer made before the first performance. Despite the generally light character of the rest of the quartet there are serious, and very beautiful movements in the Largo.

By the way, another reason for the quartet's nickname has been attributed to the fact that the six quartets of Opus 33 all have their menuetto movements marked Scherzo which, of course, is Italian for joke.

The Quartet in F, marked as Opus 3 and nicknamed "The Serenade" has denied Haydn authorship according to modern scholarship and is now thought to have been composed by Hofstetter. If you want further information about the latter you will have to dig deep. There's not much to be found in the usual authorities.

The Janacek play them all immaculately, though in the lighter movement a little less stern approach would have been welcome. However there are many Central European musicians who think our British treatment of Haydn's music disrespectfully flippant and to these the Janacek's performance will appeal mightily.

Variety Fare

Reviews of other recordings

Devotional Records

WHEN IT'S TIME TO FALL IN LOVE AGAIN. Wanda Jackson, vocal with orchestra. Stereo, Myrrh MST-6510-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney, and other capitals.)

If the above title seems a strange one for a devotional album, the explanation is relatively simple: despite the label and the source, the tracks are mainly non-devotional and mainly about that over-worked theme, love: Come On Home — Everybody's Had The Blues — Snowbird — It's A Long, Long Time — Slippin' Away — When It's Time To Fall In Love Again — Say I Do — Funny Face — Put Your Hand In The Hand — Thank Heaven For Sending Me You.

Wanda Jackson is an accomplished artist and if you like her style, complete with a very competently arranged Nashville backing, you won't be disappointed. But, as I said, despite the Myrrh label (a division of Word Records) distribution by Sacred Productions, and inclusion in our devotional section, this isn't really a devotional album. It seems more in line with the present trend of religious broadcasting, in which small doses of devotion are sugar-coated with non-controversial secular material. (W.N.W.)

★ ★ ★

RAG TIME GLORY SPECIAL. Del Wood and the First Nashville Jesus Band. Stereo, Lamb & Lion LL-1009. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

Says the jacket note: "Del Wood's Rag Time Glory Special is the most joyful, swingin', rompin' and stompin' Gospel you'll ever hear". Let me add the remark that the observation isn't too much an exaggeration. Del Wood's piano would take a lot of beating and, added to it, is a helping of Nashville pickin', a touch of bluegrass and some old-fashioned swing. It's a happy, infectious treatment of a dozen Gospel favourites: Jericho Road — There's A Big Wheel — Leaning On The Everlasting Arms — Old Camp Meetin' Time — Whispering Hope — Glory Special — Power In The Blood — Give The World A Smile — This Ole House — Brighten The Corner — Open Up Your Heart — Keep On The Firing Line.

Apart from being a happy sound for the home and for informal Gospel occasions, it could be a challenge for some of the emerging Gospel youth groups around the town. Wheel a piano out front, back it up with this kind of Nashville Sound and you'll really wow 'em! Recommended. (W.N.W.)

BECAUSE HE LIVES, Gene Gaither, vocal with orchestra and chorus. Stereo, Word WST-8627-LP. (From Sacred Productions Aust, 181 Clarence St, and other capitals).

From a christian family background, Gene Gaither pursued a career as a night club and television singer before redirecting his talents to propagating the Gospel. He is now married to well-known Word Gospel singer Mary Jayne, who heads up the backing chorus for this new Gospel album.

Gene Gaither has a smooth, pleasant voice not unlike Pat Boone. With a smooth, gently rhythmic background, it makes for pleasant listening indeed. The track titles: Because He Lives — If That Isn't Love — I'll Fly Away — The Family Of God — Sheltered In The Arms Of God — Through It All — When The Roll Is Called Up Yonder — There Is A River — On The Wings Of A Dove — Something Beautiful.

A fully imported album, the surface is clean, the sound is good and you can buy with confidence if something about it takes your fancy. Pleasant. (W.N.W.)

Instrumental, Vocal and Humour

THE WORLD OF DONALD PEERS, Vol 2. Stereo, Decca SPA.320.

Donald Peers was the hearthrob of middle-aged matrons in post-wartime Britain — the 1939-45 war I mean. If your memory goes back that far, you may remember his theme song was "By a Babbling Brook", with which he introduced his weekly half-hour radio program. Plainly then, these are pretty old tracks, although some of them appear to be genuine stereo, while others are "electronically reprocessed". Equally plainly, it is unlikely that anybody who was not a fan of his in his active singing career is going to buy this disc. Therefore, all I need do is summarise the titles: Please Don't Go — Turn the World Around — I'm a Dreamer — I've Lost My Love — Come Take My Hand — Round and Round — Games That Lovers Play — I Understand — I Love You — I Don't Know — Somewhere My Love — Give Me One More Chance.

Varied sound quality, but generally acceptable for this kind of undemanding material. (H.A.T.)

A CLASSICAL SHOWCASE. The Hamburg State Opera Orchestra (no conductor named) on Side 1; The North German Symphony Orchestra conducted by Wilhelm Rohr on Side 2. Stereo, Astor Golden Hour Series GH804.

Both orchestras play very well in this selection, which comprises the eight items from the two "Peer Gynt" suites on side 1; and Ravel's "Bolero" followed by "The Sorcerer's Apprentice" by Dukas and "Ritual Fire Dance" by Falla. However the North German players sound the more impressive, but this could be because their material offers more scope for orchestral brilliance. The sound quality is rather better than in some other discs in this series, being particularly full bodied and brilliant on side 2. Unfortunately this side suffers from a certain amount of tape hiss and surface noise. (H.A.T.)

★ ★ ★

NIGHTS IN VIENNA. The Danube Strings. Stereo, Astor Golden Hour Series GH 815.

Not good Strauss playing at all. Stiff tempos, and no sign of the typical Viennese lilt make this performance sound as that it is more suitable for the parade ground than for the ballroom. This is a pity, since the extremely generous playing time and good selection of the most popular waltzes would have made this budget-price disc a good purchase, even if the sound is somewhat dated. The 16 titles include all the well-known ones, such as Blue Danube, Vienna Woods, Emperor, Treasure, Vienna Blood, 1001 Nights, and so on. Despite their name, I doubt whether the Danube Strings live within a few hundred miles of Vienna. (H.A.T.)

★ ★ ★

BATTLING BANJOS. Arthur Smith. Stereo, Monument L 34969.

The banjo is a fun instrument, the clown of the musical world, and it is difficult to conceive of it playing a serious role. But when played by experts such as Arthur Smith and Bobby Thompson (who assists Smith in this recording), it is capable of providing splendid musical entertainment. The track which pleased me most in this selection is "Chicken Strut", with its amusing imitation of a hen woven into the musical themes, but all the other tracks provide fine entertainment. The well-known "Bonnie and Clyde" number entitled "Foggy Mountain Breakdown" is included, but you probably will not know the others, such as Battling Banjos — Feudin' Banjos — Ringing Banjos — Banjo Buster, and so on — 12 tracks in all. Technically OK, with well-spread stereo. (H.A.T.)

★ ★ ★

GOOD MUSIC LIVE AT THE OPERA HOUSE. 32-piece orchestra conducted by Tommy Tycho. Festival stereo L 35165.

According to the cover note, this album was produced "in response to radio stations' needs for more beautiful music played by Australians." But, alas, if the so-called "good music" stations start playing it, I'll turn it off. It's a pity that the Opera House is the venue for so much ordinary entertainment. Definitely a lackluytre performance. Quality is okay on all but a few of the tracks.

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

A list of the tunes includes: Theme from "2001" — For Once In A Lifetime — What Kind Of Fool Am I — Gonna Build A Mountain — Samba De Orpheu — So Nice — Quiet Night And Quiet Stars — Meditation — Brazil — Theme from the "Godfather" — I Could Have Danced All Night — Wouldn't It Be Loverly — Get Me To The Church On Time — With A Little Bit Of Luck — On The Street Where You Live — Superstar. (L.D.S.)

★ ★ ★

HARD LABOUR. Three Dog Night. Dunhill stereo. DSD 50168.

These days when you pick up a pop album you wonder whether your money buys the music on the disc or the clever ideas on the cover. For example, this album cover incorporates a manila folder with the "medical history" of "Hard Labour". And the music is often completely unexpected, such as the Prelude on the A side which has all the flavour of a carnival merry-go-round.

Some of the tracks have a blusy country and western style while "Put Out The Light" is more of what we have come to expect from Three Dog Night which was typified in their first smash hit, "Mama Told Me Not To Come". On the whole, it's an interesting album which should sell well.

The full line-up of tracks is: Sure As I'm Sittin' Here — Anytime Babe — Put Out The Light — Sitting In Limbo — I'd Be So Happy — Play Something Sweet — On The Way Back Home — The Show Must Go On. (L.D.S.)

★ ★ ★

BASIE. Count Basie And His Orchestra. Verve Recording released by World Record Club WRC S/5601.

Count Basie's economy of style in his piano playing is one of the highlights of this swinging record of ten numbers, including: I'll Get By — Shiny Stockings — Michelle — Second Time Around — South of the Border — Kansas City Wrinkles.

None of the other personnel are mentioned but they get together to make a solid sound in the usual Basie manner. The opening on side one gives a good demonstration of a subtle use of stereo as the solo piano slowly drifts across the room from one speaker to the other. As I have recently re-arranged the speakers in my lounge to give a better stereo image, this sort of thing is very noticeable. The sound quality leaves no room for complaint. (N.J.M.)

★ ★ ★

HAWAIIAN DELIGHTS. Jack de Mello Hawaiian All Stars. Stereo, Columbia SOEX 10123.

Released here on the Columbia $2.99 Green label, this disc was recorded by Victor Company of Japan. It thus represents the Japanese view of Hawaiian music, and a very entertaining and easy-to-listen-to view it is. The traditional slurring notes of the Hawaiian guitar lead the melodies throughout, but a distinctly modern touch is provided by the backing, consisting of rhythm section, electric piano, acoustic guitars, various percussion instruments, and occasional contributions from female voices. The titles include all the well-known numbers, such as blue Hawaii — Hawaiian War Chant — Hawaiian Wedding Song — Sweet Leilani — Aloha Oe, plus other more modern numbers. The recording is fine, and although not labelled as quadraphonic, the sound splits up very well when played on a 4-channel system. (H.A.T.)

★ ★ ★

DANCE PARTY No 3. Tony Back, Hammond Organ. Stereo, Interfusion Organ Showcase series (Festival) L-35116.

With his T-400 Hammond organ and Sharma 5000 rotating loudspeaker, Tony Back is capable of producing large helpings of electronic sound but here, for good measure, he has added an ARP Odyssey synthesiser, a Freeman string symphoniser and a Hohner super chromica.

On the ten tracks are medleys of 29 tunes including such titles as: Alone Again — Wand'rin Star — Yellow River — Popcorn — Sylvia — Puppy Love — Amazing Grace — Walk In The Black Forest — Tea For Two — Cry Me A River.

One of Interfusion's "Organ Showcase" series, the album probably best emphasises the integration of a Hammond organ with other sources, rather than its potential as a solo instrument. In fact, Tony Back turns the sources into a one-man combo, backed with percussion and drums. It's clean sound and, as per jacket "easy listening", provided you are partial to electronic music making and a rotating loudspeaker that does more than its usual share of winding up and down in speed. (W.N.W.)

ENCYCLOPAEDIA OF THE ORGAN, VOLUMES 9 & 11

THE ENCYCLOPAEDIA OF THE ORGAN, Volume 9: The Nordic Organ. Second period — apogee. Record two, the complete organ works of Diderik Buxtehude. Marie-Claire Alain at the organs in the Churches of St Mary at Helsingor (Denmark) and Halsingborg (Sweden). World Record Club Stereo, S-5010.

THE ENCYCLOPAEDIA OF THE ORGAN, Volume II: The Nordic Organ. Second period — apogee. Record three, the complete organ works of Diderik Buxtehude. Marie-Claire Alain at the organs in the Churches of St Mary at Helsingor (Denmark) and Halsingborg (Sweden). World Record Club Stereo, S-5040.

Two further releases by WRC in their very welcome issue of the massive Erato "Encyclopaedia of the Organ" series. As with the disc reviewed last month, these are both also part of the sub-group dealing with the complete organ works of Diderik (or Dietrich) Buxtehude, Bach's mentor, and they are both played as before by the outstanding Frenchwoman virtuoso, Marie-Claire Alain.

Like the earlier release, they are both impeccably presented, both musically and technically. Mme Alain has selected two very suitable organs for the pieces played, and plays them with her usual insightful precision. This combined with the usual high standard of Erato recordings should make them of very great interest to all classical organ enthusiasts, particularly those interested in the works of Buxtehude.

The works on the first disc comprise the Magnificat primi toni, the chorale-fantasies "Wir schon leuchtet der Morgenstern" and "Te Deum", choral-variations "Vater unser im Himmelreich" and "Mit Fried und Freud ich fahr dahin", the Passacaglia in D minor, the Prelude and Fugue in D major and the Prelude and Fugue in F major. The second disc are all chorales, nineteen in number, from the Hedar volumes III and IV.

Both discs are accompanied by detailed notes on the works, written by Mme Alain. The specification of both instruments used is also given, together with the registrations used for each section of the various works.

In short, then, excellent recordings which should be of equally high value to either organ lovers or students. (J.R.)

VARIETY FARE

SPACED OUT. Enoch Light and the Light Brigade. Quadraphonic Stereo, Project 3 PJL 33651.

Bach, Bacharach and the Beatles is a well-tried combination so nobody will be surprised by the selection on this disc, comprising: Bond Street — Lover's Concerto — Knowing When to Leave — My Silent Song — Walk On By — Eleanor Rigby — A Little Fugue For You and Me — Norwegian Wood — Ob-La-Di, Ob-La-Da — What The World Needs Now — Petite Paulette — Get Back. I gather the main purpose of this disc is to explore the possibilities of 4-channel sound, in the way Enoch Light explored the possibilities of stereo when that also was new.

Here, he uses a quite large orchestra with mixed choir as well, and supported by Moog synthesiser and electric harpsichord. Everything about the production is smooth and professional and with sounds popping out everywhere, this would be a good disc to demonstrate newly acquired 4-channel gear. (H.A.T.)

★ ★ ★

EASY LISTENING IN PHASE FOUR. Various orchestras. Decca Phase Four stereo PFS 4282.

According to the cover notes, this is not just another album of background music but that is probably what most people will use it for. The arrangements are pleasant without being memorable. Quality on most tracks is good but the first track on side one is very edgy.

Some of the "name" orchestras on the album are Les Reid, Frank Chacksfield, Ted Heath, Werner Muller, Mantovani, Edmundo Ros and Stanley Black.

Track titles are: Good Morning Starshine — By The Time I Get To Phoenix — Tie A Yellow Ribbon Round The Old Oak Tree — Wave — Song Sung Blue — Live For Life — Light My Fire — Nights In White Satin — What The World Needs Now Is Love — Alone Again — Up Up And Away — These Boots Are Made For Walking — Everybody's Talkin' — Love Story. (L.D.S.)

For your quadraphonic collection

PROVOCATIVE QUADRAPHONIC. Produced by Enoch Light. Special quadraphonic demonstration 2-record set. Project 3 (Festival) LQ-45297/8. ($7.95)

Heading up the latest batch of quadraphonic discs from Festival is this 2-record demonstration set, which the Company would dearly like to get into hifi showrooms around the nation. Unlike the usual demonstration set, this one does not intermix the tracks. Each of the four sides is devoted to a particular group as featured on other single albums.

Side 1 features "the World's Greatest Jazz Band" of Yank Lawson and Bob Haggart who play a half-dozen numbers including: A Taste Of Honey — This Is All I Ask — Mrs Robinson — Bugle Call Rag.

Tony Mottola follows, on side 2, with some highly enjoyable guitar that has a harp-like quality out front against string orchestra at rear. Typical Numbers: I don't Know How To Love Him — Volare — Yesterday — By The Time I Get To Phoenix.

On side 3, the Sammy Kaye orchestra and chorus continues the highly melodic mood, with titles like: For The Good Times — Those Were The Days — The Beat Goes On — Everything Is Beautiful.

Finally, Tony Mottola and the Light Brigade bring up the rear with: Patton Theme — The Out Of Towners — The Beat Goes On — Pieces Of Dreams — On A Clear Day — Love Is A Funny Thing — Song From M-A-S-H.

As one would expect of a demonstration set, the surface is good, the sound is very clean and the 4-channel does what one would expect of it. (W.N.W.)

Jazz and Rock...

ROCK AND ROLL ANIMAL. Lou Reed. Stereo RCA APL 1-0472-G.

This album is released just as Reed is emerging from his status as a cult figure into the general rock spotlight. He is not a teenager's artist. The subjects of his songs are too dark, sinister and deep for the lollipop brigade.

Reed uses rock as a medium to deal with problems of jealousy, pride and drug addiction. Reed seems to have taken over from the late Jim Morrison of The Doors in using rock and roll music to send telegrams from long, dark corridors.

The performance was recorded at a concert in New York at which Reed performed a number of songs associated with him. "White Heat" goes back to the Velvet Underground, a group he led 10 years ago.

Reed's music throws light on a part of the world that we are coming to understand, through necessity. He is the Kurt Weill of rock and roll, telling a tragic tale in a medium usually reserved for a good time.

Each performance is well structured to be musically interesting, even if you don't get the lyrics which are sometimes strangled. (G.W.).

★ ★ ★

JIM STAFFORD. Stereo MGM 2315 292.

Jim Stafford brings a touch of humour to country rock with the songs on this LP, which include the pop single "Spiders and Snakes".

There's good guitar and banjo playing by Stafford and two good songs about the Louisiana swamps called 'The Last Chant" and "Swamp Witch". (G.W.).

★ ★ ★

THE DINGOES. Stereo. Mushroom L 35110.

This group, of Chris Stockley, Broderick Smith, Kerryn Tolhurst, John Lee, John Dubois is the best of Australia's country rock bands. By that I mean city bands which have infused their music with nostalgia for the countryside and a questioning of city-held values. Their song "Way Out West", about a lad you took a job on a drilling rig, says it all.

There are more questions than answers in the lyrics and the Dingoes are not blind to the harshness of country life either.

The Dingoes fill the gap left in Australian music by the departure of the Flying Circus a few years back.

This LP was recorded at TCS Studios in Melbourne by John French, then sent to A and M Records in Hollywood for mastering. It has an exceptionally good sound, equal to American country rock discs and containing music which I find more appealing. (G.W.).

VARIETY FARE

AZTECS. Billy Thorpe. Stereo. Atlantic SD 1017.

After some dreadful albums, Thorpie has recorded a superb recital of rock and roll, Australian style. He is completely extroverted in his music, yet everything hangs together. With him are Warren Morgan, Teddy Tio and Gil Mathews.

From the opening "Boogie Woogie" they perform seven strong numbers, each with a strong blues orientation. Some of Billy Thorpe's records in the past have been difficult to listen to. A balance has been preserved here, both of sound and good musical taste.

Gil Mathews engineered the record at Armstrong studios, Melbourne, and this inside job might have been the secret in getting on to disc what the Aztecs are all about.

They are a rousing, spirited rock and roll band, with seldom a dull moment, and not a second of pretension.

"I Wanna Know" and "Slowly Learning Now" are two of the better tracks on the disc. (G.W.).

★ ★ ★

THE FREEDOM SUITE PLUS. Sonny Rollins. Mono. Milestone L 45385 / 6.

This re-issue of Riverside LPs of the fifties celebrates the contribution to jazz at that time of the great tenor saxophonist. The Rollins thing was to improvise on the musical theme, not so much on the chord harmonies. It took on.

In his groups he often dispensed with the piano, and the first of these two LPs, which begins with "Freedom Suite" is by Rollins with Max Roach on drums, Oscar Pettiford on bass and nobody else.

For a simple demonstration of what Rollins is about, play "Someday I'll Find You", the Noel Coward tune which starts side two.

Then move back to his imagination "Freedom Suite". It's great jazz. (G.W.)

★ ★ ★

LET IT RIDE. Chi Coltrane. Stereo. CBS SBP 234470.

Miss Coltrane is a new singer and composer who recorded this exciting album in London. She plays piano and sings.

Miss Coltrane breaks the tradition of English girl singers in the Sandy Denny mould. Unlike Miss Denny who sings baroque rock, Miss Coltrane is all soul.

Her piano style is funky, too, as she shows on "Different Ways" and "Fly-Away Bluebird". She has taken her inspiration from early Ray Charles. (G.W.).

Instrumental

SWEET GUITAR. Claude Ciari. Stereo, World Record Club S / 5564.

World Record Club, who usually provide detailed sleeve notes, tell us nothing at all here except the titles, mostly in French, the type of music (Valse, Slow Rock, Jerk, or simply "Slow") and the composers. Perhaps the best way I can describe the music is as folk-like tunes without vocals. It is all very pleasant to listen to, and should appeal to a wide range of musical tastes.

Ciari presumably plays the lead (acoustic) guitar, and he is backed by various combinations of instruments, including flute, electric and acoustic guitar, electronic organ, plus rhythm section. A moderate rock beat dominates in some tracks, but others flow gently in the normal folk style. The recording, by Pathe Marconi, is of excellent quality. (H.A.T.)

★ ★ ★

BENNY CARTER, FURTHER DEFINITIONS. Impulse Recording released by World Record Club WRC S/5579.

I don't know when this thoroughly enjoyable recording was made, including some of the jazz world's great names, but that doesn't spoil the thrill of listening to such artists as Benny Carter on alto sax, Coleman Hawkins on tenor sax, Dick Katz piano and Jo Jones on drums in a collection of old favourites. The eight titles are: Honeysuckle Rose — The Midnight Sun Will Never Set — Crazy Rhythm — Blue Star — Cottontail — Body and Soul — Cherry — Doozy. The overall quality and sensible use of stereo are of the high quality I've come to expect of World Record Club releases. (N.J.M.)

SOUND VIEWS

by Michael Barabasz
"Loudspeaker Design Engineer"

Plessey CK2 Cabinet Kit

The CK2 cabinet kit provides in one convenient pack all the necessary wood panels to make up a 2.5 cu. ft. vented enclosure for the recommended Plessey 10-inch two-way speaker system. The kit makes it easy to construct a speaker system that provides both superb sound quality and a most professional finish.

The front panel is rebated to accept the Plessey C100 bass driver, discussed previously in this column, and the new Plessey X30 dome tweeter. The X30 dome tweeter features excellent sound dispersion and is well matched to the C100 driver.

Fitted with the recommended speakers the tonal quality of the system is natural and clean with excellent bass reproduction. With up to 20 w RMS power handling the system is more than adequate to fill the normal lounge room with superb sound.

The CK2 cabinet kit was produced to assist the many people who lack the necessary tools, expertise or workshop facilities to construct enclosures. The kit contains precise precut woodwork, a grille cloth baffle, instructions and assembly aids. All panels are veneered with the exception of the front and rear panels. The side panels are accurately finished with mitred edges and tongue and groove joints so that the panels mechanically interlock. Only PVA adhesive is required to assemble the woodwork. Ingenious polypropylene straps are supplied to tension the panels after the adhesive has been applied to the joints. This ensures that the panels are accurately maintained in position while the adhesive is allowed to dry. Assembly is both simple and quick and with the mitred corner joints the final result is very professional.

It is recommended that all inner walls with the exception of the front panel be lined with Innerbond or similar acoustic material. This is best done by adhering the material to the various panels prior to assembly.

When the assembly is completed and the adhesive thoroughly dry lightly sand the enclosure. Next stain to your required colour and finish with Estapol or similar lacquer to achieve a high quality furniture finish.

To complete the enclosure you must purchase the C100 bass driver, the X30 dome tweeter, Innerbond or similar, capacitor, hookup wire, terminal strip and screws.

A paper or polyester type crossover capacitor is recommended having a magnitude of 3.3µF for an 8 ohm system or 2.2µF for a 15 ohm system. Mount the crossover capacitor between the positive terminal of the C100 driver and the positive terminal of the X30 tweeter. Connect both terminals of the C100 driver to the terminal strip and identify polarity. The negative terminals of the C100 and the X30 are then joined to complete the wiring of the system.

This circuit using a single capacitor is the most simple possible network that yields excellent results. The natural upper rolloff of the C100 driver has been utilised to eliminate the need for an inductor and due to the rising terminal impedance of the C100 at high frequencies attributed to voice coil inductance it was possible to parallel the X30 tweeter across the C100 and still maintain a system impedance of 8 ohms.

For further information contact Plessey Australia distributors direct.

PLESSEY

Plessey Australia Pty. Ltd.
Components Division
The Boulevard, Richmond, Victoria, 3121.
N.S.W. P.O. Box 2, Villawood, 2163.

AR67

Product reviews & releases

Four-digit DMM from Philips

A four-digit multimeter which combines automatic ranging with a 100 microvolts resolution on voltage measurements is a recent addition to the Philips range of digital voltmeters and multimeters. It fills an important gap in this range, combining multimeter facilities with high measuring accuracy.

Covering DC voltages from 0-1000V in four auto-selected ranges and AC voltages from 0-500V RMS in the same number of ranges, the PM2424 offers a maximum resolution on such measurements of 100uV. On current measurements the range covered is 0-1000 mA in four auto-selected ranges on both AC and DC, while resistance measurements covered are 0-10M in five auto-selected ranges. Maximum resolution on current measurements is 100 nA and on resistance 100 milliohms.

With the PM 2424 once the selected parameter button is depressed, and these cover V DC and AC, mA DC and AC and kilohms, then the given parameter value is automatically displayed on a 4 digit display unit together with, where necessary, the appropriate + or - polarity sign.

Switching between the instrument's ranges on any parameter is fully automatic, the ranging time being 200 ms / range. Should an overrange condition arise, then all the displays figures light simultaneously to provide a clear indication of overranging.

The PM 2424 also offers good performance with regard to accuracy, this being +0.01pc of reading +0.01pc of scale. Also noteworthy is the fact that the instrument employs a digital method of automatic zeroing before each measurement. This is important in ensuring a high measurement accuracy, particularly at the lower end of all ranges.

Full overload protection is also provided on all inputs. The resistance ranges are protected up to 1oV (200V for maximum 5 seconds). Also important is the PM 2424's high common mode rejection factor. This can be attributed to the instrument's use of a floating input and its integrating-type analog-to-digital converter. The latter is of the dual-slope type, and operates at 5 samples per second.

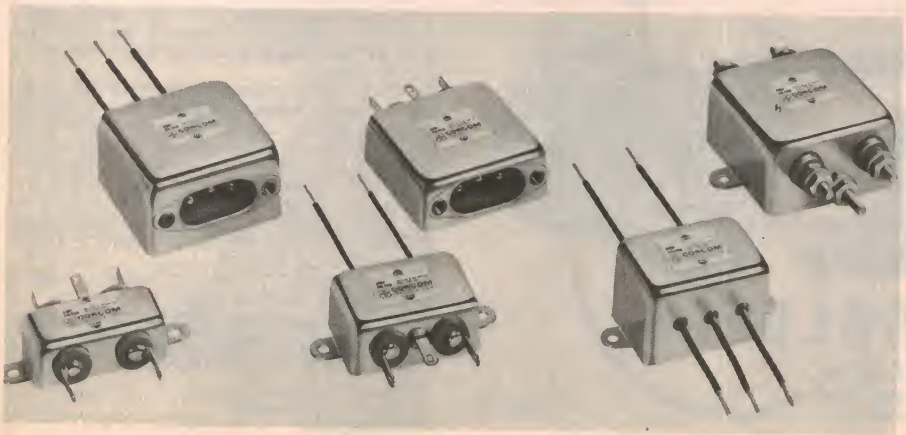
A very compact instrument, the mains-operated PM 2424 can be easily transported by hand between work sites, and can also be supplied as a battery-operated unit. Where extensions are needed to the instrument's operating ranges, then several probes are available. The first is a gigh tension probe that extends its DC voltage operation to 30kV, while shunts and a current transformer extend DC and AC measurements to 10 or 30 A and 100 A respectively.

Addition of this instrument to Philips digital / multimeter range means that the company now has four digital multimeters available to cover the full spectrum of multimeter measurement needs. The PM 2423 is an inexpensively-priced instrument featuring full automatic-ranging facilites and pushbutton selection of all measured parameters, while at the other end of the scale the PM 2421 provides pico-amp, micro-volt and milliohm resolutions on I, V and R measuremts. In between come the PM 2424 which meets needs just below those of the PM 2421 and the PM 2422A which is a reliable, well-pretected instrument somewhat superior in performance to the PM 2423.

Enquiries concerning the Philips range of digital multimeters should be directed to Philips Industries offices in each state.

Range of compact power line EMI filters from Corcom

A wide range of compact high efficiency power line RFI / EMI filters from Corcom Inc. of Chicago is now available locally from R & D Electronics Pty Ltd. of Dee Why, NSW.



The filters available in the Corcom range run from small general-purpose 1A units to heavy duty three-phase filters rated at up to 60A, and more exotic types of the spectrum.

Probably the most popular models are the compact and general-purpose B and K-series filters, available in the variety of case styles shown in the photograph. The B series filters use a double-L section configuration for effective line-to-ground filtering, while the K-series have added elements for improved line-to-line filtering. Each type is available in seven models, with current ratings from 1 to 30A. Maximu leakage current to ground at 250VAC is 1mA, and the units are tested at 2100VDC. All are recognised by Underwriters Laboratories, Inc.

For further details of the Corcom range of RF / EMI power line filters, readers are referred to the Australian representatives, R & D Electronics Pty Ltd, at P.O. Box 48, Dee Why 2099.

Versatile fault finder for electrical systems

Watson Victor Ltd are currently marketing in Australia a versatile electronic fault finder designed for tracking down faults in electrical distribution systems without the risk of re-fusing or re-closing the circuit.

Designated the Metrohm "Prospector" MK II, the new instrument is manufactured by Edgcumbe Peebles Limited of Great Britain and is the first of its type to be released onto the Australian market. In practical conditions, the unit enables a routine diagnostic procedure for fault finding. It also enables electrical circuits to be maintained and protected by correct fuse ratings.

The Metrohm "Prospector" is designed for single handed operation. A carefully designed electronic trigger circuit sends a very short current pulse of large magnitude through the suspect section of the circuit. The circuit is energised for a period varying from 20-40 milliseconds so there is no primary danger to personnel. This current is indicated on the meter scale and held in storage for as long as the test button is depressed.

Since the current pulse flows through the true path of either a normal load or a fault, the Metrohm provides an accurate and direct read-out of prospective current level. The meter is capable of reading from 0-3, 000A, and can save the cost of expensive fuselinks as well as reducing investigation time.

For further information on the Metrohm "Prospector" contact Watson Victor Ltd, PO Box 100, North Ryde, NSW 2113.

High performance oscillograph recorder

Developed from well proven flight and vehicle recorders, the S & P Twelve-Twelve is a twelve channel oscillograph recorder designed for precision laboratory work and severe field conditions.

The new unit offers paper speeds ranging from 1mm / sec to 1,000mm / sec in ten selected steps and provides full paper width timing lines at switch selected intervals of 0.01, 0.1, 1 or 10 seconds. In addition, the unit incorporates a low-cost tungsten iodine lamp to ensure reliability, and has plug-in circuit boards for each galvanometer.

Other features of the unit include: mains or battery operation, lightweight / compact construction (11kg), front-loading paper compartment, and simplicity of operation.

For further information contact Richard Foot (Australia) Pty Ltd, 63 Hume Street, Crows Nest, NSW 2065.

Multi-phase signal generator

Gearing and Watson (Electronics) Ltd, UK, have recently released a wide frequency range voltage controlled oscillator designed to provide variable frequency two and three phase power supplies.

Designated by Gearing and Watson as the Model 3P, the unit is intended to be used in conjunction with solid state power amplifiers (usually three), the system output being equal to the sum of amplifier powers. Supplies generated in this way exhibit a wide frequency response with the ability to change frequency very rapidly.

For normal operation, the amplifiers employed will use output transformers to provide the appropriate secondary voltages, and these may be connected in star or delta configurations. The resultant line voltages are simultaneously controlled in amplitude by the oscillator output control, while line voltages may be individually adjusted by the amplifier gain controls.

The oscillator also has a quadrature (90 deg) output which can be used in conjunction with two power amplifiers and a "Scot" connected output transformer to provide a three phase system at a lower cost. In this case, however, the line voltage amplitudes are not individually adjustable.

Several options are available for the oscillator. These include a remote voltage control facility which can be used in conjunction with external servo controlled and phase-lock loop systems for precise frequency control, and a variable phase output covering the range 0-360 deg in four quadrants.

Full details of the Model 3P and power amplifiers are available from British Merchandising Pty Ltd, GPO Box 3456, Sydney, NSW 2001.

NEW PRODUCTS

New range of tantalum capacitors

Plessey Ducon has released a new range of resin-dipped solid tantalum capacitors designed for use in both professional and domestic electronic equipment.

The new range employs conventional solid tantalum technology for their manufacture, with tantalum oxide dielectric and sintered anode construction. They are available in a range of values from 0.1uF to 100uF and are designed for continuous operation at rated voltage for temperatures ranging from —55deg to +85deg C. Voltage ratings are from 3-35V, depending upon the values specified.

For further information contact Plessey Ducon Pty Ltd, Christina Road, Villawood, NSW 2163.

Voltage dependent LED from Hewlett Packard

Hewlett Packard have announced the development of a new voltage dependent LED which will shortly be released onto the Australian market. The new device has a nominal threshold voltage of 2.75V. However, by using a series resistor, it can be made to turn on and off at other threshold levels. For example, by using a suitable series resistor, the device could be "on" when a supply rail is sitting at 12V, but turns off when the rail drops to 11V.

Hewlett Packard is now also offering a range of green and amber LEDs. Although not the first company to market devices with these colours, it is stated that the company preferred to wait until the colour brightness and efficiency of the new range was sufficient to allow them to be put to practical use. This aim has been realised, and Hewlett Packard state that the new amber and green LEDs (type numbers 5082-4584 and 5082-4984 respectively) offer comparable performance to red LEDs.

For further information contact Hewlett Packard Pty Ltd, PO Box 147, Gordon, NSW 2072.

WHK catalogue

WHK Electronic and Scientific Instrumentation have recently released their latest catalogue which lists a wide variety of the company's products and sales lines. Some of the products listed include ICs, LEDs, switches, heat pipes, and optical fibres. The company's address is Box 147, St Albans, Victoria 3021.

Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

Response to articles

The current publication of my "Radio Pioneers" series of articles has had some unexpected fringe benefits — by helping to discover the whereabouts of retired pioneers and also by triggering the recall of long-forgotten information.

Within days of publication I had a note from Harry Tuson, mentioned in part 3 as the operator of 2XT on the Great White Train during 1925-26. Retired for many years and residing at Eastwood, Harry confesses to "keeping well, although living a quiet life". His note continues . . . "the reference to the Great White Train reminds me that when I joined it, I have no recollection of being supplied with any tools, not even a screwdriver! The history of the Expanse B valve also reminded me of one outstanding valve supplied to me when on VHY (Ulimaroa) which gave wonderful results using only 6 volts on the anode in conjunction with a Telefunken receiver. I also took part in the (trans-Tasman) test with Charles Maclurcan when (the Ulimaroa was) off the coast of New Zealand".

The mention on page 35 of the July issue re the March 31, 1922, broadcast from Her Majesty's, Melbourne, reminded Sydney Newman, one of your avid readers from Wahroonga, that he was in charge of the installation and technical arrangements for that historic broadcast. Half a century later he has just recollected that two Browns' loudspeakers, one on either side of the stage, were used as microphones. The solid back carbon mikes which were then standard equipment with early radio telephony transmitters, were too insensitive for use in the theatre.

I hope these further comments are of interest.

Philip Geeves, FRAHS, Sydney.

Artwork compliment

I refer to the schematic drawings which have appeared over the years in EA. I would go so far as to state that they represent a very definite "Art Form".

The promptings for this letter came from observation of the circuit on page 49 of the July issue, and its comparison with the circuit on page 53.

Even although the drawing on p 53 is much less complicated, the layout is particularly clear, and it is almost immediately obvious what the circuit is intended to do.

The drawing of circuits is indeed most important, and I guess that somewhere in your organisation is a rather dedicated chap who is taking great care to arrange the circuit so that it tells a story.

Just as the boss has to take the kicks when things go wrong, so also is he entitled to any praise when things go right. But at the same time that dedicated chap might be glad to know that someone has gone to the bother of writing this note.

J. M. Wheller Auchenflower, Qld.

COMMENT: Thank you for your appreciative comments. The staff member who should receive the bouquet is Bob Flynn, who has largely set the standard for our circuits.

Components Industry

I read with interest your June Editorial Viewpoint and generally endorse your comments. You have made an assumption that the entire electronics industry is about to cease, and well it could if government actions remain as uncomprising and unsympathetic as in recent months. However, there is a ray of hope.

A clear distinction exists between consumer electronics and scientific or 'professional' electronics. This is not to imply a lack of professionalism in consumer areas, but denotes a less rigorous application for the end product. It is the consumer area that has been most affected by the tariff changes, and it is here also that retrenchments have occurred and will continue to occur for some little time.

The effects on the professional sector of the industry have not been so great. There is a continuing manufacture of high quality products, both equipment and components, that not only meet world standards but compete in world markets. This section of the industry must be retained at all costs, but it can only be retained if Industry and Government communicate and co-operate.

The impacts of changes in tariff, taxation rules, export incentives, labour and material availability and cost and several other factors were responsible, in the course of a few months, for the decline of a viable sector of Australian electronics. Most of the effects stemmed from too many changes made by the government too quickly for industry to recover. A phasing-in of tariff reductions would have allowed manufacturers to adjust to the change instead of being killed by it.

The same changes are having an effect on the viability of the non-consumer sector, but are not fatal. We await with great interest the next phase of the Industries Assistance Commission findings on the electronics industry. It will be then that we shall find whether there will be any Australian manufacture of electronic equipment or components.

In the interim, I would assure both you and your readers that we, among others, currently still produce many millions of components for an on-going electronics industry.

Peter T. S. Gray
General Sales Manager,
AEE Capacitors Pty Ltd, Preston, Vic

Books & Literature

Logic textbook

THE DESIGN OF LOGICAL MACHINES, by Jean Florine, translated from the French and edited by Allan Cownie and Evelyn Hynes. Published by The English Universities Press Ltd, London, 1973. Hard bound, 160 x 227mm, 259pp., many diagrams. Suggested price in Australia $12.00.

A very rigorous and systematic textbook on the design of digital logic systems, by the noted authority, Professor Jean Florine, principal of the Laboratoire des Systemes Logiques et Numeriques at the University Libre in Brussels.

The book is divided into two main parts. The first, comprising nine chapters, introduces the basic concepts of logical algebra, the different types of logical problems, the methods of logic system analysis, and the basic principles of semiconductor logic circuits. It then progresses to deal with the logic equations and circuits covering basic elements in combinational, sequential and memory circuits, and concludes with methods of analysis and synthesis of combinational logic functions.

The second part of the book builds on this foundation by discussing the more exotic area of automatic synthesis of logical machines, and describing Professor Florine's unique and pioneering special purpose computer designed to synthesise combinational logic systems automatically. The book then ends with a bibliography and a topic index.

The book is fairly deep, and will mainly be of interest to serious students. Although the discrete semiconductor circuits discussed in some of the chapters are now rather dated, this should not detract from the undoubted value of the book as a textbook.

The review copy came direct from the publisher, who advised that copies should be available here through Hodder & Stoughton (Aust) Pty Ltd. (J.R.)

IC primer

QUESTIONS AND ANSWERS ON INTEGRATED CIRCUITS, by R. G. Hibberd. Published by Newnes-Butterworths, London, 1974. Hard covers, 118 x 172mm, 96pp, with diagrams. Suggested price in Australia $2.50.

An introductory book on ICs, written in the question-and-answer format which some writers believe to be easier to read as well as being somewhat easier to write. I'm not convinced of this myself, but this little book is certainly well presented, and would be well worth inspection if you're in the market for a basic introduction to the subject.

It is divided into seven sections, dealing respectively with 1 — Basic Aspects; 2 — IC Technology; 3 — Digital ICs; 4 — Linear ICs; 5 — MOS ICs; 6 — MSI and LSI; 7 — The use of ICs.

While each individual topic is dealt with very briefly, the explanations given are in most cases quite clear and concise. And they are well served by illustrations, although one or two of these appear to be a little inaccurate.

In all, though, it should make a good introduction to ICs for those who still find them completely foreign. And at the price it is very good value for money.

The review copy came from the local office of the publisher, who advises that stocks should be available at all major bookstores. (J.R.)

Novice guide

NOVICE RADIO GUIDE, by Jim Ashe, WIEZT. Published by Communications Technology, Inc, Greenville, New Hampshire, 1974. Soft covers, 154 x 228mm, 143pp, many photographs and diagrams. Price in Australia $3.95 plus 40c postage.

A book prepared by the editors of Ham Radio magazine, and designed as a first primer for those working towards the novice level amateur radio operators licence granted by the FCC in the USA. As such it may well be of value to those studying for the new Australian novice licence, when this comes into force.

As one might expect, it is strongly biased in the direction of practicality. This is indicated by the chapter headings, which read: 1 — Introduction to Amateur Radio; 2 — Basic Communications Technology; 3 — More Communication Technology; 4 — A Simple Radio Receiver; 5 — How to Build a Radio Transmitter; 6 — Antennas; 7 — Setting Up Your Amateur Station; 8 — Learning the Radio Code; 9 — Accessories and the Amateur Lab; 10 — Important Working materials.

The text is clearly written, and is well served by illustrations. At the quoted price it is very good value for money.

The review copy came from Technical Book and Magazine Co, of 289-299 Swanston Street, Melbourne. (J.R.)

Synchro converters

SYNCHRO CONVERSION HANDBOOK, First Edition, edited by Steve Muth. Published by ILC Data Device Corporation, Bohemia, Long Island, 1974. Soft covers, 140 x 215mm, 108pp, many diagrams. Price in Australia $3.95.

A fairly specialised little book, written for those concerned with the application of synchro converters — the interfacing units which make it possible for digital computers to monitor the physical movements and shaft rotations in machinery, using synchros or "selsyns". It is quite general, and not tied exclusively to DDC products, making it very suitable as an introduction to the subject.

The review copy came from Allied Capacitors Pty Ltd, of P.O. Box 198, Brookvale, NSW 2100. Copies are available from this firm at a cost of $3.95 posted, within Australia. (J.R.)

Analog modules

NONLINEAR CIRCUITS HANDBOOK — designing with analog function modules and ICs. Edited by Daniel H. Sheingold. Published by Analog Devices, Inc, Norwood, Massachusetts, 1974. Soft covers, 138 x 210mm, 502pp, many circuits and diagrams. Price $7.95.

A book designed to help engineers, technicians and students understand and learn to design with the many analog function modules and ICs now available. In his preface the editor also notes that it will hopefully tend to make the reader aware of the many exciting applications for these modules — particularly those made by the publishers!

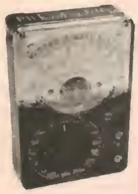
This admission of commercial motivation should in no way deter the reader, because the book is actually a very well presented and up-to-date text on analog function modules and their applications.

It is divided into four sections, dealing respectively with basic operations, applications of nonlinear devices, understanding nonlinear circuits, and aids for the designer.

If you're a bit hazy about function generators, logarithmic circuits, multipliers, etc, it's well worth acquiring — and good value.

Available from the local representatives for Analog Devices, Parameters Pty Ltd, at 68 Alexander St, Crows Nest 2065. (J.R.)

MODEL RH-20 $20.00
Packing & Postage $1.00.



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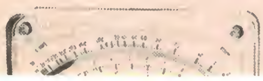

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The Amateur Bands

by Pierce Healy, VK2APQ

"Intruder Watch" needs your help

The amateur service is internationally recognised as a self disciplined organisation. In Australia, as well as other countries, this aspect is extended to policing amateur frequencies against illegal intrusion from other services.

Those who do not belong to their national amateur radio society, may not be aware of an organisation called the intruder watch. The work of this organisation is performed by members of national societies in many parts of the world.

In Australia, the intruder watch is one of the activities of the WIA,and operates under a federal co-ordinator appointed by the WIA federal council.

Here are some interesting facts from the WIA federal co-ordinator, Alf Chandler, VK3LC.

The WIA intruder watch was established by the federal council in 1967. Its object is to preserve the few remaining frequencies available to amateurs.

By observing and reporting intruders, commercial or otherwise, it is hoped that at least some may be removed by information passed to the PMG Department's Radio Branch, and a subsequent official complaint to the administration concerned.

Since its inauguration, many observations and reports have been submitted to the authorities and recently action has been taken to rid the bands of blatant intruders.

It is well known that there are a lot of broadcast station intruders in the 7MHz band. However, many are in China and iron curtain countries, and are extremely difficult to bring into line. But not all. In several instances broadcasts and spurious emmissions falling within that band have been removed.

As federal co-ordinator, Alf, by liaison with the Radio Society of Great Britain, the American Radio Relay League and the radio branch PMG's Department in Australia, is able to keep track of what is going on. It is because of reports passed to him by observers and relayed to these organisations that some intruders have been persuaded to quit using amateur bands. Cases in point are:

TCX — a teletype station situated in Ankara, Turkey was operating on 1410kHz. A readout from an observer was sent to the RSGB who issued a complaint which had the desired effect.

KJG — a teletype station situated in Yugoslavia was operating on 14285kHz. Similar action was taken and an apology received by the RSGB from the Yugoslav administration.

Some intruders are identifiable by call sign, others are not. By liaison with co-ordinators in Region I and Region II, signals can often be identified by comparison of frequency and traffic content.

Alf concluded his comments with:

"There are too few observers in Australia, most operators being content to put up with the interference. I would like to see more amateurs and listeners taking interest in the movement.

"If this plea should fall on sympathetic ears, a note to the co-ordinators in the various states or to me would be greatly appreciated. Co-ordinators are as follows:-

Federal — Alf Chandler, VK3LC, 1536 High Street Glen Iris, Vic. 3146

Victoria — Albert Cash, 20 Alamein Street, Morwell, Vic. 3384

Q'land — Murray McGregor, VK4KX, 6 Murray Street, Red Hill, Qld. 4059

Sth. Aust. — Leigh Cotton, VK5LG, 64 Weeroona Ave. Parkholme, SA 5043

W. Aust. — Ross Greenaway, VK6DA, 22 Salisbury Street, Leederville, WA. 6007.

Tasmania — Harry Hancock, VK7MZ, 6 High View Cres., Devonport, Tas. 7310.

"Unfortunately, at the time of writing, NSW was without a co-ordinator. Bill Jenvey, VK2ZO, who acted in that office for several years has taken up an appointment in Nauru. However, I am hopeful of an early appointment.

"Every month I receive from the RSGB co-ordinator, G3PSM, a four or five page summary of intruders heard in Europe, and also a summary from the ARRL, but from reports received in Australia, I can only compile a quarterly summary of any size. I am sure Australian amateurs and listeners can do better. For more information write to Alf Chandler, VK5LC."

It should be noted that the final remarks from Alf should not be interpreted that less interference occurs in Australia. In fact it is a plea against the apathy towards the problem.

LOCAL AND OVERSEAS NEWS

JAMBOREE ON THE AIR

The weekend 19th and 20th October, 1974 is the date for this popular world-wide event when amateurs assist Scouts and Girl Guides throughout the world to exchange greetings of friendship with each other.

Next month these notes will contain some interesting facts about the Jamboree-on-the-Air. Amateurs and scout masters should make suitable arrangements now which will enable as many as possible to enjoy this unique opportunity.

REGION II

The United States FCO has issued, under a new ruling, the call sign W30HI for the Amsat-Oscar B satellite. (OSCAR 7 after launch.) However, the FCC has waived its identification rules to permit identification to be limited to the last two letters, the familiar "HI".

REGION III

The popular VK / ZL / Oceania contest takes place in October as usual. As these notes were compiled the rules had not been received. However, the dates are:

5th and 6th October, 1974	Phone section.
12th and 13th October, 1974	CW section

JARL AWARD

On the 29th May, 1974, Bill Hall, VK2XT, of Toronto, NSW, was awarded certificate number one for being the first amateur outside Japan to make two-way contact with amateurs in all Japanese cities. There are 644 cities and Bill made this outstanding achievement on the 21MHz band.

It is believed that only two amateurs in Japan have gained this very difficult award, both on the 7MHz band.

RADIO CLUB NEWS

RADIO CLUB DIRECTORY

A reminder to secretaries and publicity officers. The deadline for inclusion in the "Radio Club Directory" in the December 1974 notes is the 16th October.

The information required appeared in the July issue of these notes.

To avoid missing this opportunity to publicise your club — send the information NOW.

SOUTH WEST ZONE CONVENTION

An invitation is extended to amateurs and their families to attend the South West Zone Convention at Wagga Wagga, NSW.

Date: Saturday 5th and Sunday 6th October, 1974.
Convention site: Lake Albert Hall and Sporting Ground, approximately six miles from the centre of Wagga Wagga.

Brief details of program:

Saturday:
9.00am to 3.00pm — 40 metre contest (details below)
9.00am onwards — Registration Bring own lunch.
2.00pm — 146MHz Hidden transmitter hunt.
2.30pm — Second 146MHz Hidden transmitter hunt.
7.00pm — Drinks prior to the Official dinner.

Note: during the afternoon various contests and activities will be provided for the wives, children and non-competitors. A full evening's program has also been arranged by the entertainment committee.

Sunday:

10.00am	— VHF scramble
11.30am	— 40 metre transmitter hunt.
12.30pm - 2.00pm	— Lunch (available at site).
2.00pm	— 146MHz fox hunt.
2.45pm	— VHF scramble for the ladies.
3.00pm	— 146MHz talk-in transmitter hunt
4.00pm	— pedestrian transmitter hunt.
5.00pm	— Prize giving.
6.00pm	— Barbeque, followed by films.

Note: Miscellaneous entertainment and contests arranged for ladies and children during the day's program.

Accommodation: Accommodation is difficult during this holiday weekend. Motel bookings will not be available after 31st August. Bookings after that date will probably be in nearby towns. If accommodation is required please send details to Allan Bull, VK2BUT, 67 Fernleigh Road, Wagga Wagga, 2650, with a minimum deposit of $10 before 31st August 1974.

Rules — 40 metre Contest

Participants — Amateurs attending the South West Zone Convention.

Date — 9.00am to 3.00pm Saturday 5th October, 1974.

Aim: For mobilers and home based operators, attending the convention, to contact each other as many times as possible in accordance with the following rules:

1. Stations can be re-worked every half hour.
2. Points cannot be claimed for working stations whose call signs are not subsequently registered at the convention.
3. Home station, mobile or portable operation is allowed, with all points being entered on the same log sheet. All points are additive.
4. Standard five figure scoring system to be used and a readable log sheet, showing points claimed, times etc. must be handed in by 3.30pm on the Saturday.
5. Operators may continue to score until 3.00pm, provided operation takes place in excess of 800 metres from the convention site.
6. Scoring the convention site base station only permissable after a special "CQ South West Contest" call is given by the base station operator. Rule 1 above also applies.

Scoring: Contacts between:-

Home stations	1 point
Home and mobile stations	2 points
Mobile and home stations	2 points
Mobile and mobile stations	3 points

Any contact with convention base station 3 points

Note: The convention base station will be continuously monitoring around 7110KHz to provide information required by visitors, as well as participation in the contest.

Central Coast Amateur Radio Club

At the June meeting on Friday the 21st, there was a good attendance to see colour slides of the Western Australia mining areas. The slides were taken by Arthur Keane who recently toured the areas. Arthur's discription of the areas, and other highlights of the trip, provided a very enjoyable evening.

The VHF mobile equipment clinic scheduled for Sunday 30th June had to be cancelled due to the illness of Peter Campbell, VK2AXJ. It is now planned to hold the clinic in September. Members who wish to have their equipment checked must ensure that it is at least in working order and provide connecting cables for the units.

The subject for the AOCP class in July was antennas. Instructor Alec Swinton, VK2AAK used a very practical way of dealing with the subject. The class spent the day with Alec at his QTH, where all the likely and some unlikely types of "sky-wires" were demonstrated. There were quads, Yagis, quarter-wave ground planes, rhombics, collinear arrays and a G5RV with a couple of helical whips for good measure. The class had an excellent grounding in antennas and should have no trouble with any question in the AOCP examination.

Blue Mountains Radio Club

Three members of the Blue Mountains Radio Club have been successful in recent PMG examinations. John Oxley, a sixth form student at the Springwood

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR BANDS

High School, gained his AOLCP. David Noble, a student of the University of New South Wales, also gained the AOLCP. However, activity on the bands by both these members will be restricted until completion of their academic studies.

Neville Chivers of Faulconbridge, VK2ZYO, passed the Morse code exam for the AOCP. Neville already has a transceiver awaiting a full call sign.

Illawarra Branch

The Illawarra Branch reports that there are four amateurs on the staff of the local television station, WIN 4. They are VK2YCH, VK2ZJX, VK2ZMM and VK2ZVX.

Darryl Harman, VK2YAS, has passed the Morse code examination and is now VK2BLS. Charlie Proctor, VK2ZEN, has also passed and is awaiting his full call sign.

Lyle Patison, VK2ALU, leader of the moonbounce project, reports that approval has been given by the PMG's Department extending the high power permit until April 1975. The permit has been extended to cover F1 and F2 modes (radioteletype) in addition to the A1 and A0 modes.

About 30 hours' work has been done on the new transmitter frequency source unit. It is now operating but a temporary crystal is being used as the special crystal is somewhere among the accumulation of undelivered mail.

Other work is the installation of a heater box in the transmitter cubicle. This is designed to prevent the corrosion of relay contacts. This job was done by VK2ZHU. Correcting a defect in the antenna dish tracking drive is being done by VK2BHL.

Tests arranged for VK2AMW with Canadian, American, English and Rhodesian stations by VE7BBG were conducted on the 22nd June, 1974. The first series, over a three hour period, commenced at 10.00 am with six stations in the USA, including K2UYH on RTTY.

The only EME signal heard was from K2UYH on CW. The moon could not be seen during the tests as it was less than ten degrees away from the sun. Later, at sunset, a test was made with ZE5JJ in Rhodesia, and with G3LTF. The only signal heard was a very loud radar signal reflected from the moon.

A check of the Nautical Almanac revealed that all tests had apparently been scheduled in error about two hours later than the correct time. This is the first time such an error has occurred. Lyle says in future all schedules will be checked as soon as they are received.

The Illawarra Branch, NSW division WIA, meets on the second Monday of each month in the Committee Room, Wollongong Town Hall, at 7.30 pm. Visitors welcome.

Further information from the secretary, Ian Bowmaker, VK2ZJA, PO Box 110, Dapto 2530.

Eastern Zone — VK3

The Latrobe Valley repeater VK3RAB, operating on new channel 2, has been in operation since 2nd March, 1974. The location is the ABLV4 television transmitting station on Mount Tassie, south of Traralgon in Gippsland. The service area is equal to or better than the original surveys indicated. Reliable mobile coverage is provided within a radius of 120 kilometres and serves most of the VHF FM operators in Gippsland.

When interference tests have been completed it is hoped to attach the antenna to the side of the TV transmitting mast. Graham Colley, VK3QZ, is officer in charge of the repeater.

The annual meeting of the Eastern Zone was held in the Morwell 1st Scout Hall on Saturday evening, 22nd June, 1974. Twenty persons attended, including three council members of the Victorian Division WIA and Bob VK3BMA, officer in charge of the WICEN activities in eastern Victoria. Bob headed a very interesting discussion on the future of WICEN, especially in the Gippsland area.

Office bearers elected were:

President: Ted Allchin, VK3YGI
Vice-president: Bruce Hockings, VK3ADB
Secretary: David Scott, VK3DY
Acting publicity officer: George Francis, VK3ASV.

Bruce Hockings, VK3ADB, has been co-opted to the Victorian Division, WIA council, and will represent the Eastern and other country zones at council meetings.

For those operating two metres FM mobile along the Princes Highway, Rex Corthorn, VK3VG, at Mallacoota, 24km from the NSW border, keeps a look out on that band.

George Francis, VK3ASV, reports test with a repeater from Mount William in Western Victoria on channel 1. A service radius of 130 kilometres is being obtained, with an even greater coverage to the north.

Central Gippsland Youth Radio Club

The Victorian supervisor of the YRCS, Frank Whittom, VK3BAN, announced that the Central Gippsland Youth Radio Club won the pennant for the most successful non-school YRCS club in Victoria during 1973. The supervising instructor is Brian Young, VK3-BBB, who accepted the pennant on behalf of the club at a YRCS seminar in Melbourne on Saturday, 29th June.

The CGYRS runs classes at Traralgon and Trafalgar on Tuesday evenings. The club call sign is VK3AYE.

Gold Coast Radio Club

A highlight among the coming events is the VK4 division convention. This will be over the weekend, 5th and 6th October, 1974, at the RSL Hall in Southport.

Sir Bruce Small will deliver the opening address at 2.00 pm on Saturday, 5th October.

From the Gold Coast business houses there will be displays of colour TV equipment, laser navigation and distance measuring equipment, stereophonic and quadraphonic audio equipment.

Contact secretary Mike Adams, VK4ZDA, PO Box 558, Southport, Qld 4215, for further details.

The Australian Volunteer Coast Guard Association, Queensland Flotilla 1, and the Gold Coast Radio Club plan to discuss the possibility of the two organisations affiliating. The main objectives are for the QF1 to become associated with people familiar with radio operation, etc, to train their members, and to man their station, VJ4RE, during weekends.

The GCRC would, in return, gain permanent headquarters in the Coast Guard building when completed, including a room to store club equipment and the club station, VK4EI.

Judging from the amount of work completed, the Gold Coast repeater should be in operation when these notes are read.

The repeater will receive on 146.10MHz and transmit on 146.70MHz. The antenna system will be two, five half-wave co-linear arrays mounted on a 30-metre winch-up mast.

The club welcomes visitors. For full information contact the secretary, PO Box 588, Southport 4215.

University NSW Amateur Radio Club

Members held a two-day tour of the Hunter Valley on the weekend 20th and 21st July, 1974. A highlight was a visit and inspection of the Maitland Radio Club. Mobile operation was another feature of the trip.

The exhibition at the Centrepoint shopping complex in Sydney, arranged by UNSWARS members and Dick Smith Pty Ltd, to publicise amateur radio, was very successful.

A demonstration station and information desk was manned from 10.00 am to 8.00 pm between the 6th and 11th May, 1974. Visitors were introduced to the WIA Youth Radio Club Scheme. It has been estimated that there were about 40,000 visitors.

The success in recent PMG examinations, among those who attended the UNSWARS study classes, was extremely high. Twelve candidates gained the AOLCP four the full AOCP and three who had held their AOLCP gained the AOCP.

Two students, one of whom had never done a science course, highlighted the success of the UNSWARS course. They are Bruce Maguire and Graham Innes. Both are totally blind and started their studies with no previous knowledge of electronics or radio. They became interested in amateur radio as the result of a demonstration organised by UNSWARS at the North Rocks School for blind children. Bruce, who completed fifth form high school last year, obtained the full licence. Graham, who completed sixth form last year, gained a limited licence and is keenly preparing for the Morse examination. Graham did the course by correspondence, and is now living in Cairns, Queensland.

Maitland Radio Club

The first Morse examination to be conducted by the club as a compulsory subject for the YRCS elementary certificate was held in mid-June. Candidates were required to write down the Morse code symbols beside groups of letters set in random order. From the 14 candidates 13 gained 99pc pass.

The value of this simple test is very apparent to the club instructors. In the past only a few students knew the Morse alphabet, a few were trying to learn it, but the majority were not doing anything.

Morse code is a compulsory subject for the proposed novice type licence as well as for the full AOCP. There are now 19 persons capable of joining in the Morse code practice classes. Without this new requirement there would have been only two.

The club now has an FT200 transceiver and contacts have been made with many overseas stations. A transceiver fund was opened some years ago and a recent donation by the Maitland City Council made it possible for the club to finally obtain the unit.

In June three members, Phillip Ellicott, Craig Beavis and Robert Cummings, enjoyed a free joy flight over Maitland and Newcastle districts. The three were award winners at the Maitland Show. The flights were made possible by the Royal Newcastle Aero Club which assists the MRC each year with flights as a show prize.

Some of the biggest working bees have taken place at the MRC premises in preparation for the YRCS State Supervisors' Conference at the end of August. The first was painting the exterior of the club premises and the second laying a concrete path from the street to the entrance.

For details of the MRC contact the secretary, A. J. Watson, PO Box 59, East Maitland, NSW 2323. Telephone Maitland 37 2282. Visitors welcome.

Geelong Amateur Radio — TV Club

Plans to refurbish a section of the club rooms at an estimated cost of $200 are being considered. This is to provide a 5 metre by 4 metre social room, enlargement of the workshop area, and a new parts division and store room. The work on the social room will include carpeting and covering the walls with decorative plywood.

On the holiday weekend in June members visited an amateur radio convention in Mt Gambier, South Australia. The VK3 visitors outclassed the VK5s in the field events in their own territory. Daryl St John, VK3AQR, was awarded the trophy for the best overall performance at the convention.

June produced some surprise band openings on six metres. Club members in Geelong, VK3AQR, VK3AMZ and VK3ASQ, worked several stations in the Sydney, Orange and Tamworth areas, NSW, and unstated locations in Queensland. Signals peaked to strength nine. Early in June co-channel interference was reported between TV Channel 0 stations in Queensland and Melbourne. Signals from TV stations 0, 1, 2 and 3 were received in Geelong at good strength.

The GARC rooms are in Storrer Street, East Geelong. Meetings are held every Friday night. For details write to the secretary, David Mann, PO Box 520, Geelong 3220. Telephone Geelong 9 4261.

Moorabbin & District Radio Club

Members, led by Adrian Mensforth, VK3ZCM, participated in the Moorabbin Youth Expo held on the 1st, 2nd and 3rd July, 1974. A 9very good selection of amateur equipment was presented. Various attractions such as slow scan TV, closed circuit TV and RTTY were used in the display. The stand created a good deal of interest among vjsitors.

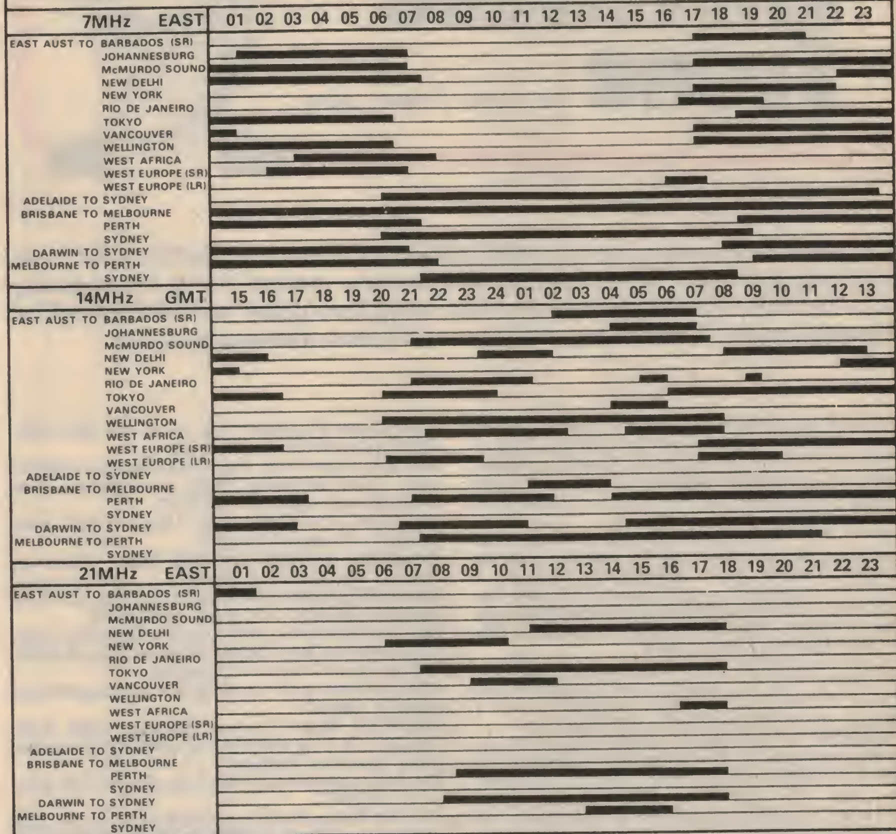
The ladies' auxiliary has been busy and a "spokesman" is to be appointed to express their views to club members.

Social evenings at club members' homes have assisted club finances. A film night in May raised $40.

The MDRC meets on the first and third Friday of each month at 8.00 pm in the Moorabbin Baseball Clubrooms. Write to the secretary, Michael Park, VK3ASH, Flat 2, 6 Melbourne Street, Murrumbeena 3163. Telephone 568 0136.

IONOSPHERIC PREDICTIONS FOR SEPTEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. **9.74**



Western Australia VHF Group

Due to efforts by a small group, progress has continued on the headquarters area of the museum project at Wireless Hill. A large concrete block has been removed from the old engine room in preparation for its being used as a meeting room.

Shelving has been erected to stow the smaller items collected for the display of old radio equipment.

John Watson, VK6JW, lives in the caretaker's house and is on the site nearly all the time. He will welcome any assistance on the museum project. Anyone interested, and with an hour or two to spare, should contact John on telephone 64 1558.

The organising committee feel that progress on the project will produce long term benefits to the VHF Group and amateur radio in Western Australia.

Westlakes Radio Club

The wet weather that had dogged members for months let up in June and construction work on the new club rooms has been completed. Donations have also been received which will assist in paying for the sewerage connections.

The comments of the club secretary, Eric Brockbank, VK2ZOP, on the situation are:

"Never has club unity been so very strong and active participation so prominent. The stakes are large and the final conclusion brings its own reward. The club has done much under extremely difficult conditions and has emerged with flying colours.

"You could not begin to understand the situation until you have struggled for eight years. Don't take our word for it, come along and have a look at the progress being made." The final comment is an invitation to those interested in youth activities, electronics, and amateur radio who reside in the Newcastle and Lake Macquarie area. The new club rooms are in York Street, Teralba.

Information on the Westlakes Radio Club may be obtained from Eric Brockbank, VK2ZOP, Box 1, PO, Teralba 2284, or by telephoning club director Joe Waugh, VK2IQ, on (Newcastle) 68 2642.

Western Suburbs Radio Club — VK3AWS

The lectures and social interests provided by the Western Suburbs Radio Club attract an attendance of about 70pc of the total club membership. Meetings are held at the club rooms of the Melbourne Caravan Park, 265 Elizabeth Street, East Coburg, at 8.00 pm, on the first and third Friday each month.

During the past ten months the WDRC has run Morse practice sessions on the 160 metre band. As a result the number of limited licensees in the Melbourne metropolitan area who have gained their full licence, is greater than ever before. Among the Morse code session operators is Miss Norma Boyle, VK3AYL.

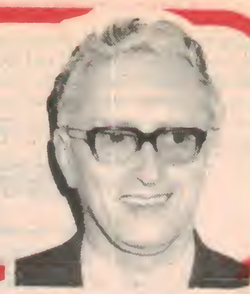
Club members operate on all bands and most modes from 1.8MHz to 1296MHz. Several are active on ATV, and the 146.65MHz FM net frequency is used extensively.

The vice-president, Tony Atkins, VK3ATR, states that membership includes short-wave listeners, experimenters, tinkerers as well as licensed amateurs.

For further information write to the secretary, Les Johnson, VK3ZPB, 115 Mitchell Street, Maidstone 3102, or telephone 317 9245.

Shortwave Scene

by Arthur Cushen, MBE



The past winter season has provided favourable reception conditions for Latin American stations, and has resulted in many new stations being heard during our afternoons. These stations are now being favourably received during the late evening, and promise to provide us with further interesting signals.

COSTA RICA: Radio Universidad at San Pedro has been heard at our listening post on 6107kHz, closing at 0357GMT. The station has typical Spanish programming with frequent identification, and has already verified a reception report from Stephen Greenyer of Invercargill NZ.

ECUADOR: Radio Nacional Progreso at Loja has confirmed our reception with a friendly letter in Spanish, together with photographic material, a recording of greetings on tape and a local coin. The station now broadcasts on 5060kHz, which replaces the former 4775kHz, and has the call sign HCEH3. The radiated power is listed as 200W.

Radio Zaracay has been heard opening at 1015GMT on 3390kHz. This transmission causes interference to, Radio Universidad, Merida, Venezuela, which operates on 3395kHz and opens at 1000GMT.

DOMINICAN REPUBLIC: Radio Clarin, in its verification letter to Chris Davis of Featherston NZ, lists a radiated power of 3kW on 4850kHz and states that they also operate on 11700kHz with 50kW. However, this latter frequency has not been heard. The verification came in the form of a letter and pennant and was signed by Neit Rafasl Nivar Besz, Administrator.

BOLIVIA: According to Sweden Calling DXers, a new Bolivian Station, Radui Alfonso Padilla, located at Padilla-Chuquisaca, is operating on 3490kHz from 1100-1200 and 2200-0200GMT.

ARGENTINA: Several Argentine stations have been heard by Chris Davis, and these include Radio Splendid on 5985kHz which broadcasts news in Spanish at 1000GMT. Another good signal is Radio Nacional Buenos Aires on 6060kHz and heard opening at 0900GMT, while Radio Nacional Mendoza on 6180kHz has been heard around 0940GMT. Radio Belgrano on 6090kHz is noted under VLI-6 Sydney at 0950GMT.

HONDURAS: Station HRWW, operating on 5972kHz, has been heard opening at 1100GMT. Reception was possible during a recent auroral disturbance when signals from Central America were received with little interference from stations in Asia normally using the same frequency. HRWW has the slogan "La Voz de Centro America" and is located in San Pedro, Sula.

URUGUAY: The short-wave stations at present active in Uruguay were recently listed in Sweden Calling DXers, and one of these include SODRE on 9620 and 15275kHz. This station broadcasts from 1200-0300GMT. Radio Sarandi on 9515kHz operates with 10kW, 0930-0400GMT, while Radio Oriental on 11735kHz is scheduled from 0900-0400GMT. Radio El Espectador uses 11835kHz and broadcasts from 0900-0400GMT.

INDONESIAN SIGNALS

Craig Tyson of Perth WA, reporting in the New Zealand DX Times, points out that there have been many changes by stations in Indonesia since the 1974 World Radio Handbook was published. This makes it essential for the listener to get exact studio location during the station break to ensure positive identification. Some of the most interesting stations heard recently are:

2584kHz Radio Daerah Yogyakarta heard relaying news from RRI Yogyakarta at 1400GMT

3445 Radio Sairan Pemerintah Dacrah Kabumasuan Pasuruan (East Java) has local identification at 1400GMT, then news.

3459 Radio Pemerintah Daerah Kabumasuan (RPDK) Bima (East Sumbawa) noted in Indonesian from 1100GMT until sign-off at 1600GMT.

3462 RPDK Pasuruan (East Java) noted from 1100GMT till sign-off 1600GMT.

3474 RPDK Jombang observed from fade-in at 1010GMT till sign-off at 1600GMT.

3895 RPDK Sukohardjo (Central Java), observed from fade-in at 0915GMT till sign-off at 1600GMT.

4000 RRI Pontiamak heard on this frequency some nights, sometimes on 3965kHz. Sign-off is at 1515GMT with full identification in Indonesian.

4000 RRI Tanjung Karang observed from 1515GMT till 1600GMT sign-off.

4089 RPDK Blitar (west of Malang) noted from 1200GMT till after 1500GMT. At 1400GMT the station relays news from Surabaya.

4535 Radio Sukohardjo noted from 1000GMT till sign-off at 1305GMT.

5938 RRI Medan heard with identification at 1230. The program consists of advertising and announcements.

WORLD'S TALLEST TOWER

The Polish Radio recently celebrated its 30th anniversary with the opening of a new station which boasts the world's tallest tower and most powerful transmitter. The new station is located at Konstantynow. The mast is 2120 feet or 642.5 metres high and the radiated power of the transmitter is 2000kW. This new station broadcasts the Home Service program of Radio Warsaw and operates on 227kHz. According to an item in Sweden Calling DXers, the new station is located 40 miles west of Warsaw in Central Poland.

SRI LANKA PROGRAMS

The Sri Lanka Broadcasting Corporation is received on several frequencies. At present, the broadcast in English on 11725kHz around 0200GMT provides the best reception. According to the Radio DX Club of India, the latest schedule for the National Service is heard with Tamil from 0030 until 0300GMT and from 1230 until 1700GMT on 4940kHz. Sinhale is broadcast from 1125 until 1710GMT on 4901kHz and 3385kHz. The Commercial Service has English from 0030 until 0300GMT on 5020kHz.

ARMED FORCES SERVICES

The American Armed Forces Radio and Television Service provides good reception on several frequencies during their round the clock operation. The transmissions are carried to the Far East, Latin America, Europe, and Africa from transmitters located in the United States and in the Philippines. The present schedule is:

kHz	GMT	Transmitter
5995	1200-0030	Philippines
6030	0600-1100	Bethany
6095	0900-1415	Delano
9700	0800-1630	Delano
9755	0230-1300	Bethany
11790	1730-2300	Greenville
11805	0500-1000	Delano
11805	1430-1630	Delano
11840	0030-1200	Philippines
11900	2330-0300	Bethany
15330	1230-2400	Bethany
15330	1830-2300	Bethany
15330	2130-0700	Delano
15430	1330-2300	Greenville
15430	1330-1730	Greenville
17765	2130-0500	Delano

HCJB FREQUENCY CHANGES

Radio HCJB in Quito, Ecuador, broadcasts to the South Pacific on 6085kHz and 9745kHz. The frequency of 6085kHz is on the air from 0500-0900GMT, and then moved to 6050kHz for the period 0900-1100GMT. The broadcast on 6050kHz has now been replaced by 6075kHz, and is transmitted in Quechus, German and Portuguese. The other frequency change is for the period broadcast in Russian from 0830-0900GMT. The new frequency is 9715kHz and this suffers interference from Radio Nederland, Bonaire, while the new frequency of 6075kHz suffers interference at 0900GMT from Radio Sutatenza, Colombia.

NEW PIRATE RADIO

Last year, a pirate radio station with the slogan "The Voice of Peace", broadcast on 1540kHz off the coast of Israel and was heard in New Zealand around dawn.

The ship closed down recently and, according to the Dutch Press, its owner, Abi Nathans, has sold the vessel to a group of Belgian business men for $300,000. A new floating radio station, with the slogan "Radio Benelux", is expected to commence operation shortly on a frequency at the upper end of the medium-wave band. The vessel will be located in International Waters off the coast of Holland and will have a transmitted power of 9kW.

KUCHING USES 5005kHz

Radio Malaysia at Kuching, Sarawak, is using the new frequency of 5005kHz, and is widely reported by listeners in Australia and New Zealand. Jack Buckley of Sydney, NSW, reports reception around 1030GMT, while our reception has been at 1400GMT when news in Malay is broadcast. The news is preceeded by a time signal and full station identification.

The frequency offers fair reception with some side band from WWVH on 5000kHz and Singapore on 5010kHz.

LISTENING BRIEFS

AFRICA

EGYPT: Radio Cairo is now providing good reception in New Zealand during the English period from 0200-0330GMT. The broadcast on 9475kHz is actually beamed to North America.

ALGERIA: Radio Algiers has been heard by John Mainland of Wellington NZ on the new frequency of 11915kHz. The station opens at 0600GMT in French. A program in English is also broadcast on the same frequency from 1900-1930GMT and, according to the station announcement, they are also using 154209 and 17835kHz. Programs in French are heard before and after the half hour srvice in English

TANZANIA: According to a report in Sweden Calling DXers, radio Tanzania at Dar-es-Salaam has dropped 6106kHz for its External Service and is now heard only on 15435kHz

The frequency of 6105kHz now carries programs in Kiswahili right through until sign-off at 2100GMT. The External Service, which includes a program in

ASIA

TAIWAN: Radio Liberty is no longer operating from Taiwan, the facilities having been taken over by the Broadcasting Corporation of China. According to Dene Lynneberg of Wellington NZ and Robert Jones of Sydney, the station's assigned frequencies, including 15125kHz at 1030GMT, have been observed with Voice of Free China programs in place of Radio Liberty programs.

SOUTH KOREA: Big power increases for stations in the Korean Broadcasting System are forecast with the signing of a contract to provide two 250kW MW units and one 250kW SW unit, as well as associated studio and antennae equipment.

NORTH KOREA: According to Sweden Calling DXers, Radio Pyongyang is using several new frequencies. These include broadcasts at 0400-0455GMT on 9370 and 12070kHz in Spanish; 0500-0550GMT on 9977kHz in English; 0800-0850GMT on 7405 and 9895kHz in Korean; 1400-1450GMT on 9370 and 12070kHz in Russian; 2100-2150GMT on 9977kHz in French and 2200-2250GMT on 9370 and 12070kHz in Korean.

CHINA: The Chinese People's Liberation Army Fukien Front Line Broadcasting Station, which

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

operates on several frequencies, has been verified by Lindsay Robinson of Invercargill on 5170kHz. The station confirmed reception with a letter in English, and is heard from 1000-1850GMT.

MEDIUM-WAVE NEWS

NEW ZEALAND: Station 1XX at Whakatane has become the first private commercial station in New Zealand to be granted a licence for a repeater station. 1XX is currently operating on 1240kHz. The repeater, which is situated at Murupara, uses the same frequency and has a radiated power of 100W.

PHILIPINES: Station DWAY on 1323kHz has been heard in New Zealand by Eric McIntosh of Invercargill at 1130GMT. At 1200GMT, a news bulletin in English was presented, and this was followed by a gospel session.

QATAR: The BBC Monitoring Service reports that a 750kW MW unit feeding a six-mast directional antenna system is to be erected at Al Arish, which is the site of the present transmitters. A second 250kW SW transmitter is also to be installed to supplement the present sevice.

BULGARIA: A new high-powered transmitter carryng te programs of Radio Sofia is now in opration. the transmission is on two frequencies: from 0530-1630GMT they use 575kHz, and from 1631-2130GMT they use 1223kHz.

TURKEY: According to Craig Tyson of Perth, WA, three Indonesian stations have beeen heard on medium-wave. Radio Antar Nusa, Jakarta, is now using a frequency of 1285kHz. The long established radio Jakarta transmitter is now received on 1331kHz from 1100-1600GMT, while radio Nanggala, Jakarta, is now using 1373kHz in place of 1470kHz.

BASIC "SHORT FORM" KITS FROM KIT PARTS LTD

ELECTRONIC DOORBELL. A two transistor circuit complete with necessary components and small speaker. Has provision for 2 door bell push switches (front and back door). The push switches aren't provided but can be obtained from any electrical store. It provides two different tones, one for the front door and one for the back. **Cost $5.40.**

LIGHT SENSITIVE MUSIC GENERATOR. A small unit which emits a musical tone, the pitch of which is determined by moving your hand over a light sensitive device. Contains 2 transistors, speaker and components. Simple to build. **Cost $5.20.**

MORSE PRACTICE OSCILLATOR (speaker version). A 2 transistor device with a small speaker that permits you to practise morse code. Runs off a 6 or 9 volt battery. All parts except morse key provided. **Cost $4.90.**

COMPRESSOR / PEAK LIMITER. A simple design which really works well. Runs off 6v DC or off your 6.3v AC heater chain. This kit includes a built in rectifier for operation off the heater chain. Ideal for your Ham rig, PA system, tape recorder, guitar amp (specially suited to bass guitar to give that rich 'chunky' sound). Incorporates fairly fast action and slow decay. Can be adjusted for peak limiting or compression. Can be fitted simply to any audio amp. Kit contains all the components plus circuit and explanation of function. **Cost $6.40.**

CODE PRACTICE OSCILLATOR (earphone version). Simple compact little unit drives a magnetic earphone. Very pleasant tone. Kit contains earphone, transistor, all parts except morse key, and circuit. **Cost $3.90.**

METAL LOCATOR. Detects metal to a depth of 18". Can be fed into a pair of headphones, either low or high impedance, or to a small amplifier. Full pictorial details for building the search coil. Also diagram for recommended layout. Gives rather outstanding performance for such a simple device. Entirely portable with all up weight of only 2 lb. Great for finding metal objects under the sand at beaches. **Cost $7.95.**

COLPITTS XTAL OSCILLATOR. For testing xtals. Handy to have around. Kit contains xtal socket, xstr, components and diagram. **Cost $2.70.**

TRANSMITTER FOR RECORD PLAYER OR GUITAR. Transmits at top of broadcast band, with adjustable tuning. Plug in a guitar or record player and transmit to your nearest radio. Only a foot or so of aerial wire is required to cover 20ft. Kit contains 2 xstrs, prewound coil, variable capacitor, all necessary components and diagram. NB. It is illegal to connect a microphone to this unit for the purpose of xmitting voice. Really simple to build. **Cost $4.90.**

ELECTRONIC SIREN. Exceptionally realistic — can be hooked onto a large amplifier if required. Contains its own small speaker. Ideal for junior to mount on his bike. Contains 2 transistors, speaker, push switch, components and circuit. **Cost $4.90.**

VHF RECEIVER. One of our best sellers. Suitable for covering from 27-130 mcs with different coils. Uses one transistor and operates on the super regenerative principle. Little external radiation. Can be used in conjunction with a standard transistor broadcast receiver by merely standing the VHF receiver against the transistor radio, and tuning the transistor radio to a clear point on the dial. Also fitted with an audio output for connection to a high impedance earphone or external amplifier. All pieces including metal front provided. Step by step pictorial assembly instructions included. Easy to build. Listen to police, taxis, aircraft, fire brigade, etc. Fascinating night time entertainment. No external aerial needed — only 3 ft of stiff wire. **Cost $5.40.**

PROXIMITY ALARM. A simple passive proximity alarm. Anyone approaching within one to three feet of it (depending upon how it's set) will operate the built in relay. Ideal as a simple burglar alarm, to detect milk box thefts, peeping toms, etc. Excellent proximity alarm for jewellers, etc. Ideal as a capacity switch to activate displays. Completely self contained — only 4 transistors — battery operated. This device operates on a static charge principle and is very popular overseas. Kit includes components, instructions and circuit. No metalwork or layout. This is left to your individual taste. **Cost $8.90.**

STROBE FLASHER. Produces incredible stroboscopic flashing light effects — used by dance bands for stage lighting effects. Our circuit uses ordinary light bulbs rather than expensive 'strobe' bulbs — easy to build and set up. Will drive 6 standard 100 watt light bulbs — adjustable flash from 'Sunburst' (one flash in 5 seconds) to 30 flashes per second. Incredible effects. **Cost $8.40.**

BAXANDELL TONE CONTROL. A 2 transistor tone control circuit — ideal for adding in front of our 5 watt amp (kit No. 49) or **any** amplifier circuit. Max input level 200mv. Input impedance 200k ohms. Output 50k ohms. Operates off 9-18 volts with a slight gain of up to 6db. Treble and bass response approx 16db cut and lift at 40cps and 20,000cps. Uses 2 low noise silicon transistors. Complete with bass and treble potentiometers and all components. **Cost $3.90.**

5 WATT AMP. A very popular kit — can be assembled in under 2 hours with only a basic knowledge of electronics. Step by step pictorial instructions. Only 4 xstrs, 10 resistors, and 5 condensers to solder in place. Operates off 9-18 volts. Runs off battery or power supply — power supply circuit provided. Input impedance 20k ohms. Input sensitivity 20mv. Output load 3-15 ohms. Everything, including tag-board, provided (not metal base). **Cost $6.00.**

5 WATT AMP WITH TONE CONTROL. This is a combination of our 5 watt amp (kit 49) and our baxandell tone control (kit 48) mounted together on a silk screened printed circuit board. Can be used in conjunction with a ceramic or xtal cartridge. Two of these units make a high quality stereo amplifier. Input impedance is 200,000 ohms which can be raised by adding a series resistor. Input sensitivity is better than 20mv. Can be run off a battery for low power. Kit includes PC board. **Cost $9.90.**

HEE HAW SIREN. A highly realistic European style siren which operates a loudspeaker (supplied with kit) when turned on. Runs off 9 volts. Ideal for children's trikes, pedal cars, etc. A real attention getter. Tag board and complete step by step pictorial instructions provided. About 3 hours of work required to construct this unit. **Cost $6.80.**

250 MW AMP. A simple 3 transistor amp which comes with a 3" high impedance speaker. Input impedance is 30,000 ohms and sensitivity is 20mv. Tag board provided, along with pictorial layout and constructional details. Assembly time is about 2 hours. A handy little general purpose amp — runs off 9 volts — can be used with either negative or positive earth. Handy for amplifying the output of a xtal set or other small signal output devices. **Cost $6.50.**

HOMODYNE TUNER. From Electronics Australia Nov. 1973. This is the discrete component version of this kit which has proven to be one of our most popular sellers. This kit is complete to the last nut and bolt and includes an attractive anodised cabinet and silk screened front. The heart of the unit is a pre-aligned permeability tuner and a handful of components with PC board. Only a voltmeter is required to align the tuner. Performance is crisp and clear. Operates off 12 volts. Feeds any amp with its 500mv output. Cabinet and metalwork prepunched. Full instructions supplied. Average assembly time 4-6 hours. **Cost $24.00.**

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INFORMATION CENTRE

ELECTRONIC BONGOS: I would like a little help with the Electronic Bongos (File 1/EM/23). First, what would be the smallest output amplifier I could use without the Bongos overloading the input. I would like to use a compact amplifier if possible as I am going to build it in a drum. Also the hand held probe — is it possible to do away with this altogether? I hope you can help me. Keep up the good work, your magazine is the best there is. (J.M., Clarence River, NSW.)

You are confused between two amplifier parameters, sensitivity and power output, and the two are what we might call independent variables. You can have a very sensitive amplifier with low power output, a high power amplifier with low sensitivity, or vice versa. The sensitivity of an amplifier is the signal required to drive it to full power.

Since the output signal from the Bongos is fairly high at about 0.5V RMS you could plug into the auxiliary input of any stereo amplifier. Alternatively, a simple economical amplifier with power of about 15 watts can be built using just one power amplifier board, volume control and the power supply from the Playmaster 136 described in December 1972 (File 1/SA/39).

If you are playing in a situation where there is a high hum level due to mains wiring, you may be able to eliminate the probe, as noted in the article.

HELP! I have just obtained a Kingsley radio receiver, model K/CR/11, but I have no circuit or other information on it. Could you please print my name and address so anyone with information could contact me? (S. Rhodes, 103 Main Ave, Wavell Heights, Qld 4012).

Your wish is our command . . .

MUSICOLOUR Mk II: We are having trouble with the Musicolour Mk II. a couple of Triacs have shorted, so too have PUT's and a FET. It gives me the impression that the unit is unstable in some way. Are there any modifications to it at all? (J.D., Torwood, Qld.)

No circuit modifications have been published on the Musicolour and as far as we know, none have been warranted. We do not know how the unit could become unstable unless the supply filter capacitor began to go open-circuit.

PLAYMASTER 136: I have constructed the above unit from parts supplied in kitform from one of your advertisers. I would like your advice on two aspects: 1) Bass, with controls in the level position, seems overstrong. All component values have been checked and comply with the ratings.

However, the voltages are not spot on. The 21V spot reads 23V, 19V reads 20V, 8V reads 10V and 9V reads 8V on Tr3, and 8½V on Tr7. These last two are in the tone control circuit.

Would the bass emphasis be caused by this voltage variation? If so, how would I rectify this? Secondly, the quadraphonic effect works on phono only. Is this correct and if no can you suggest what is amiss? (H.S., Ashburton, Vic).

The voltage variations in your amplifier are small enough not to cause any concern and they have no effect on the frequency response of the amplifier. It is more likely, that the "electrical" centre of the bass control does not coincide with the mechanical centre of ratation. If you can check the response, set the control knob to give a flat response in the 12 o'clock position.

The "quadraphonic" effect should work on any stereo source. The fact that you are obtaining the effect on phono but not on other sources indicates that you are either using a mono source or the inputs are not wired correctly.

ENTHUSIAST: Over the past ten years I have built some thirty of the projects featured in EA which I regard as the best of any such magazine. The latest project was the Playmaster 136 amplifier. Like many others, I suffered snags with reversed connections on transistors but now it seems to be working okay. I have a minor problem with the balance control which has to be hard over to one side to achieve equal output. It's no great inconvenience and I'll check it sometime.

I've also had some frustration with the EA 160 SSB receiver but now have it working very well indeed using a tuneable IF covering 4.9 to 5.5MHz.

I am enclosing some ideas you may be able to use in future projects in the magazine. Trusting you will continue to keep up the good work. (B.T., Howick, NZ).

Thank you for your long and detailed letter, B.T. As you can see we have condensed it somewhat. We shall keep your ideas in mind for future projects.

LETRASET: You constantly refer to "Letraset rub-on lettering," yet I find no reference to this in any advertisement. As I live some distance from a capital city and my shopping is done through your magazine I would appreciate information on this. Keep the projects flowing and thanks for such a useful source of information on "the state of the art." (B.G. Pt Lincoln, SA).

"Letraset" dry transfer lettering should be available from most newsagents in a handy package. It is also available in full sheet form (with hundreds of different letter styles and designs) from Letraset Aust Pty Ltd, 346-348 Kent St, Sydney 2000.

MUSICOLOUR 2: Because I am unable to purchase a printed circuit board for the Musicolour II I am considering transferring the design to Veroboard. However, I am worried that in some circumstances the active supply could be connected to the common tracks. I have thought of leaving one track unused and perhaps removing the copper altogether. Also, I considered using heavy gauge wire in some places to prevent heavy current flowing through the tracks. Is this in order? (G.P. Auckland, NZ.)

We cannot understand the difficulty in obtaining a printed board, GP. As far as we know, there are at least two manufacturers in New Zealand, and either should be able to supply boards,. Your design philosophy seems to be in order, but we cannot take any responsibility, nor can we offer any assistance if it fails to work or causes damage. The two board manufacturers in NZ are: Printed Circuits Ltd, PO Box 2193, Christchurch, and Mini Tech Manufacturing Co Ltd, PO Box 9194, Newmarket, Auckland.

COMPONENTS: I am building a Playmaster 128, but am unable to obtain 250uF 64VW electrolytics. The closest I can get are 220uF 100VW. Are these satisfactory? (P.G., St Lucia, Qld).

Yes, P.G. They are quite satisfactory. If anything, the increased voltage rating makes them better.

SOLID STATE: What does it mean? This term nowadays is prevalent in our reading matter, be it editorial or advertisng, it is beautifully engraved on equipment, obviously to proclaim something. Hi-Fi I can relate to high fidelity, but with solid state I am at a loss. Can you offer an acceptable explanation? (T.J.W., Bentleigh, Vic.)

The term solid state is applied to equipment which contains only semiconductors as active devices, as distinct from thermionic valves. It stems from the fact that semiconductor devices rely on effects within a solid crystal.

EXTRA C: In the thyristor train control with simulated inertia (March 1967) the parts list calls for 3 0.47uF capacitors, while the circuit and wiring diagrams only call for two. Could you enlighten me? (W.M., Netley, SA.)

The circuit and wiring diagram are correct — only two capacitors are needed.

ELECTRONIC THERMOMETER: If you ever publish how to make one, I'll build one and give it to our family doctor — an electronic clinical thermometer. You'll appreciate the need for this if you've ever tried to hold a so-called "½ minute" mercury thermometer under a child's armpit for five minutes while trying to get a reading!

Ideally one would think the electronic clinical thermometer should have a three digit LED readout with a range of 35 to 43 degrees Celsius, change-over "palatable" sensors suitable for little mouths, and be a compact, battery operated unit with a "push to read" switch, incorporating a battery level indicator. (J.S.R., Wahroonga, NSW.)

Thank you for your suggestion, J.S.R An analog version of what you seem to want has been described in EA, at least in an elementary form. The Electronic Thermometer was featured in the September 1968 issue (File No 2/MS/17) and another version in the July 1971 issue (File No 2/MS/22). With suitable

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As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2). A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 80c per issue-reprint. Thus, a project spread over three issues will cost $2.40. Reprints are available for all projects, but no material can be supplied additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 40c per page.

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REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 80c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

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ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield 2014.

probes, these may be suitable for use as you have described. For a digital unit we're afraid you'll have to wait a little longer.

DEAD LETTER: We are holding a letter addressed to Mr R. Bourne, 32 Willow Ave, Manningham, SA5086. This has been returned by the postal authorities marked "Unclaimed" (from two addresses). If Mr Bourne will advise us of his present address we will forward the letter to hom.

IMPEDANCE PROBLEMS: In regard to your PA Amplifier/Mixer as featured in the June, 1972, issue, are you absolutely certain that it is designed for microphones having an impedance of 100k. The highest impedance microphone that I have been able to locate in Adelaide, Melbourne, or Mt Gambier is 50k. Can you help by supplying me with the name of a firm where I can obtain a 100k unit? If not, is there any way of overcoming impedance matching problems with a 50k unit? (G.S., Lucindale, SA.

There are no impecance matching problems G.S. The input impecance has been purposely designed to be higher than the impedance of the microphone so that the microphone is not loaded when it is connected to the amplifier. The input impecance of the two microphone inputs is correctly stated in the specifications panel and in the text as 100k. As such, the inputs are suitable for medium to high impedance dynamic microphones, and this includes those types having an impedance greater than 10k. A mcrophone having an impedance of 50k is therefore quite suitable for this amplifier.

NOTES & ERRATA

SCOPE SWITCH (July, 1974, File 7/C/27): On the circuit, there are some errors: Tr4 and Tr6 should be 2N3638 and not 2N23638; the file number should be 7/C/27 and not 7/C/26 and the negative line of the DC supply should be connected to chassis. On the wiring diagram, the two copper strips accommodating the rectifier diodes should be cut so that the transformer secondary winding is not shorted out.

New arrangement for PM140 transistors

We present here details of the mounting arrangements for use with the Texas Instruments equivalents of the power transistors used in the Playmaster 140 power modules.

Since the article in the July issue, we have managed to obtain samples of the Texas Instrument devices equivalent to the Fairchild AY8171 and AY9171 types. These proved to be electrically identical, but differed in mechanical construction to both the Fairchild and Philips types.

The Texas Instruments TIP31B and TIP32B are packaged in a plastic TO-126 style case, similar in appearance to the SOT-32 types. However, they differ in having the base and emitter leads transposed with respect to the Philips types.

This means that they cannot be mounted as shown in the previous article. Instead, they must be mounted on top of the heatsink, and the leads must be bent downwards so as to pass through the holes in the heatsink. As before, the centre lead must be cut off, as the collector connection is made via the heatsink.

Do not forget to thermally bond the transistors to the heatsink using silicon grease, and do not omit the washer under the nut of the mounting bolt. This is to prevent damage to the case of the transistor. Excessive force must not be used when tightening the mounting bolts.

The heatsink is mounted in the same way as before, using ⅛ in. machine screws, in conjunction with spacers made from nuts. (D.E.)

Computer chimp from P33

In order to eliminate any ambiguities in what is being said, Dr Rumbaugh collaborated with Ernest von Glaserfield and Pier Pisani to develop Lana's computerised language which has been called "Yerkish" in honour of the Primate Research Center's founder, Dr Robert M. Yerkes. The rules of Yerkish grammar are programmed into the computer and, if Lana is trying to command the operation of any of the automated food dispensing devices in her room, the computer will accept and relay only those messages that are in correct Yerkish.

Thus, for example, if Lana pushes the word buttons in the following sequence, "Please, machine, give milk," an automated dispenser will fill with milk. If Lana says, "Please, machine, make milk," the computer will reject the sentence. While it may be tempting to accept the sentence as a good try, it is, in strict Yerkish, nonsensical. The only things the machine can "make" are "window open," "music," or "movie."

After a year and a half in training, Lana, who is now three and half years old, has learned 71 words. However, Dr Rumbaugh and Tim Gill both say that they have concentrated not so much on expanding her vocabulary but rather on teaching more sophisticated concepts and uses of words. For example, Lana knows the names of colours. If a picture of a blue ball is projected on her room wall and Lana is asked, "What colour of this," she answers, "Blue colour of this." If, on the next exchange, she is asked, "What name of this," she readily composes a new sentence, pressing the buttons "Ball name of this."

All of Lana's words and sentences are recorded by a computer-controlled typewriter. Because the computer is left running every night. Dr Rumbaugh has had an opportunity to see what Lana tries with language when she is alone. She often asks the machine to play a movie or recorded music.

"We feel," Dr Rumbaugh said, "she is about to convince us that she has language. What we are looking for is to have a continuing and meaningful conversation with her." Dr Rumbaugh looks forward to the day when Lana can become a partner in behavioural studies of other chimps, reporting in Yerkish the meaning of various things chimps do in their own societies. Toward that end, he expects that Lana's training will continue for many years, provided adequate research funds can be found.

It is apparent then, that the achievements of those chimps currently under study are growing so rapidly that it may be seriously questioned whether man can long continue to claim to be the only animal that uses language. The issue is not likely to be resolved within the forseeable future however, as there is no generally accepted definition of language against which to measure the chimps' achievements. Some sceptics contend that the chimpanzees are exhibiting nothing more than rote learning or stimulus/response conditioning, a contention which, at this stage, cannot be proven or disproven.

One possible application of the new technique could be in efforts to communicate with retarded or autistic children who fail to learn language under conventional teaching methods. If researchers can devise ways to unlock the chimpanzee's limited intellect, such methods may also be of value with human beings of limited mental abilities.

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1.2 Volt, fully charged, 4in x 3in x 1in 4 AH
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P & P 30c.

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Frequency Meters.
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Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only **$6.50** P&P 55c.

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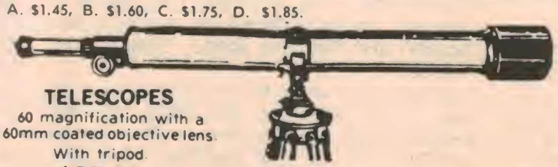

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With tripod.
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3in x 2in containing 2 valves, qty. of resistors, etc.
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1-800 CYCLES
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2½in DIAM. 2in FL. $1.50 each. Or $2.50 per pair. P & P 20c.

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Volts A.C. and D.C. 15 to 1000 volts (3 Scales) Current D.C. 150 M.A. Resistance 1000 K Ohms Only **$8.95** P&P 55c.

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ALL MUSICAL INSTRUMENTS, amplifiers and accessories. Electronic calculators, cassettes, etc, buy from local & overseas wholesalers & mfrs through us, extra special deals for quantity buyers. Mail order music dept. Lethean, PO Box 55, Albert Park, Vic 3206.

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BASIC ELECTRONICS, the popular handbook for beginners and advanced experimenters alike, is still available from Electronics Australia, Box 163, Beaconsfield 2014. Price is $2.40 including postage.

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SUPER BARGAIN PACKS at incredible prices — RESISTORS (Mixed), 5pc, 10pc, ½w, 1w, ideal for servicing, V.H.F. or hobbyist — 100 for $1. (Top Quality). POLYESTER CAPS, Top Quality, 160v, 270v, 400v, 10pc Tol. in a range of values — 100 for $3.50. POTS — Duel, single, switch and Tab pots (no rubbish) — 20 for $4. CERAMIC DISC CAPS, mixed — 50 for $1 (Miniature). ELECTROLYTIC CAPS mixed — 25 for $2. STYROSEAL CAPS — 25 asstd for $1. TANTALUM CAPS — All miniature, mixed — 20 for $2 (No junk). ZENER DIODES — Mixed 1w types, 10 for $4.50, Mixed 10w types — 10 for $7. SWITCHES — Including Rotary, Toggle and Pushbutton switches — 10 for $5 (value at least $12). TAG STRIPS — Mixed, 50 for $2. Post and Pack 20c or extra for heavy parcels. **MICRONICS**, P.O. Box 175, Randwick, N.S.W. 2031.

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Broadcasting Technical Officer, Grade 1, required in Closed Circuit T.V., involving recording and replay operations. T.V.O.C.P. or E.C.C. or equivalent qualifications required.

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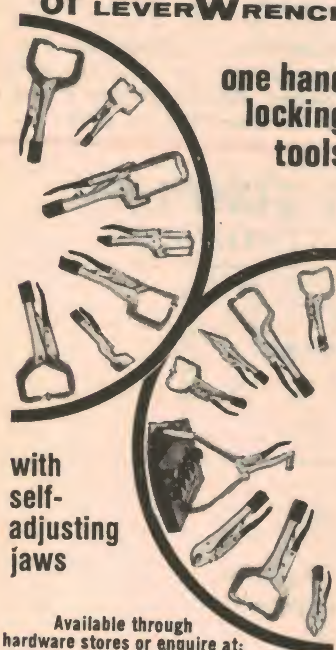

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For Electronics Australia's new handbook, "Projects & Circuits", containing over 30 of the most popular projects which have appeared in the magazine, plus circuit ideas too! All this for only $2.00 plus postage.

PROJECTS & CIRCUITS: Available soon from newsagents, most parts suppliers, or direct from Electronics Australia office.

INSTRUMENTATION AND MEASUREMENT. An intensive residential Course at the University of New England, Armidale, NSW, 30th November-6th December, 1974. This Course has been designed for engineers, technicians, research workers, management executives — in fact, all engaged in the design, manufacture, operation or distribution of modern instrumentation. It covers the bases of measurement, design of instruments, classes of measurement sensors, data processing, information retrieval and promotion of hardware. For brochure detailing the Course please write or phone:—
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For those who wish to mount their VHF two-way radios (single or multi channel) to meet Vehicle Safety Design Rules 18 and 21, Transport Dept approved control heads, cables, universal cradles and PMG approved crystal switching modules are available for: AWA MRT 6,25M; Pye leader; Victor; Overlander; Phillips 1680, 1676; Weston LM230, 501; Crammond CTR 18; Rangemaster MR10; Vinten MTR 20 and 21. From the manufacturer:

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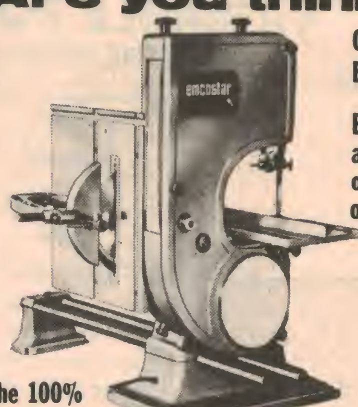

Circular Saw, Band Saw, Fret Saw, Jig Saw, Belt Sander, Disc Sander, Box combing set.

Basic unit performs all above functions and ten other operations with optional accessories

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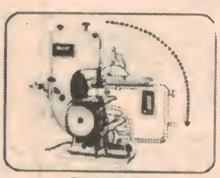

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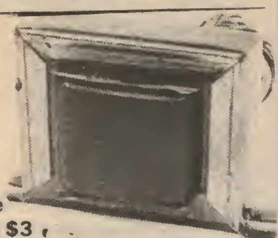
TV Picture Tubes. New in cartons 21 inch 110 deg. **$22**, 17 inch 110 deg. **$18.**

T.V. channel change and fine tuning Knobs **75c** a pair.

TV tuners new in valve type or transistor **$10** each.

Switch 5 Pos 1 Toggle 240/V **50 cents.**



Power Transformer, 150 Volt aside 6 Volt Winding **$3**

G11302 Magnetic Cartridge $48
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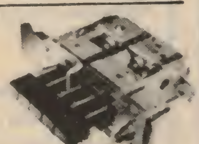
BSR G11204 latest record changer Balancer Arm Going Device etc. **$42.**

PHILIPS GRAMOPHONE MOTOR
6 volts, 4-speed, and pick-up **$7.75.**

SUIT HOMODYNE TUNER
Car Radio Push Button Tuner
$4.50
Pack & Post 55c Interstate 85c



SLIDE SWITCH
3 position **50 cents**

Stereo amplifier and tuner solid state 10 watts per channel RMS new well known make **$50.**

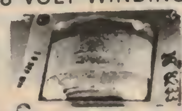
Speaker transformers 7000 to 15 Ohm 3½ watt **$1.25.**

100 mixed condensors micas polyester ceramic fresh stock **$2** per pack and post 25c.

Perspex tops for record players size 12 x 9⅜ x 3¼ **$1.50.**

50/Ohm pots ideal for ext. speakers etc **50c.**

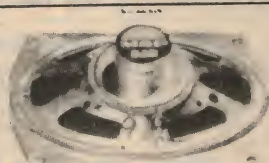
POWER TRANSFORMER 240 VOLTS 2/6.3, 1/18 VOLT WINDINGS **$4**



in 8 or 15 ohm

$3.50

6" x 4"



MSP 6½" Speakers
8/OHM **$4.50**
15/OHM **$4.50**

6½"

8" x 4"
$4.50

TUNING AND BALANCE INDICATOR METERS **$1.50**

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Speakers Magnavox 8 inch 4/OHM **$5**

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Amplifiers 5 x 3, 5 x 1½, 5 x 2½, 6 Volt complete ideal for record players also preamp stage included **$8**

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Pots 30 mixed values including ganged and concentric **$5**

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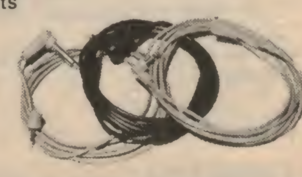
Stereo Speaker Wire **12 cents** yard

Speakers 8 WR Magnavox 15 OHM **$9**

CURLED EXPANDER WIRE 20FT. **$1.50**

6.5 mm Jack Plug and 7 Ft. Shielded Cable	75 cents
6.5 to 3.5	75 cents
3.5 to 3.5	75 cents
Jack Plug Sockets	35 cents



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These precision built units not only offer the best features of stereo turntables costing twice as much, but have a very special added advantage . . . they all have 4 channel (CD4) ready status. In fact all that is required is a 4 channel stylus.

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with a choice

CD-4

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